The Wireless World
THE PRACTICAL RADIO JOURNAL
27th Year of Publication

No. 953. THURSDAY, DECEMBER 2ND, 1937. VOL. XLI. No. 23.

Proprietors: ILIFFE & SONS LTD.

Editor:
HUGH S. POCOCK.

Editorial,
Advertising and Publishing Offices:
DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1.

Telephone: Waterloo 3333 (50 lines).
Telegrams: "Ethaworld, Sedist, London."

COVENTRY: Hertford Street.
Telegrams: "Autocar, Coventry." Telephone: 5210 Coventry.

BIRMINGHAM:
Guildhall Buildings, Navigation Street, 2.
Telegrams: "Autopress, Birmingham." Telephone: 2971 Midland (4 lines).

MANCHESTER: 260, Deansgate, 3.
Telegrams: "Iliffe, Manchester." Telephone: Blackfriars 4412 (4 lines).

GLASGOW: 26B, Renfield Street, C.2.
Telegrams: "Iliffe, Glasgow." Telephone: Central 4857.

PUBLISHED WEEKLY. ENTERED AS SECOND-CLASS MATTER AT NEW YORK, N.Y.

Subscription Rates:
Home, £1 1s. 8d.; Canada, £1 1s. 8d.; other countries, £1 3s. 10d. per annum.

As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

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EDITORIAL COMMENT

Relays and the Post Office

An Explanation Needed

IN our issue of November 11th we drew attention to the fact that the Post Office showed signs of taking an active interest in the question of the relay broadcast services, and we emphasised that evidence was available to show that if once the Post Office set its hand to the task of taking over the existing relay organisations, as authorised to do by the Government's acceptance of the Ullswater Committee's Report in 1936, we might expect that the job would be undertaken on a wholesale scale and the full resources of the Post Office would be applied to developing relays as a method of distributing broadcast programmes throughout the country.

We suggested then that the Post Office owed it to the public and to the radio industry to make known their intentions in advance, because of the revolutionary effect which such development of the relay service by the Post Office on a national scale would have.

Arguments can be put up in favour of making the Post Office telephone network a medium for the distribution of intelligence in case of emergency. To be able to call up by telephone every subscriber in the country or in a given district simultaneously, in order to convey an emergency message, would be a most valuable facility, and since there is so much discussion to-day in regard to national defence, the value of providing such means of communication must not be lightly esteemed.

Emergency Precautions

We have on several occasions pointed out the weakness of broadcasting alone as a means of direct communication with the public, because so large a proportion of domestic receiving sets operate from electric supply mains which might fail and so cut off large areas at a time from the broadcast transmissions, and we have suggested that crystal sets might be available as a standby. But it is well known that broadcasting stations and other wireless transmitters to-day provide an excellent guide in aerial navigation, and it might well be that any country which suffered from air raids or an aerial invasion would wish to close down all wireless stations likely to provide landmarks to guide an enemy. To be able to silence the broadcast stations and switch over to a relay system provided by the telephone network would be valuable in any defence plan. This, we feel, may be a justification for Post Office activities in connection with the relay services.

No Substitute for Radio

From a general survey of the question we consider that at this point the Post Office enterprise should end and it should not be pushed to the extent of providing the subscriber with more than the local or national programme, so as to avoid as much as possible incursion into the sphere of activities built up over so many years on the basis of the present distribution of broadcasting.

It seems unthinkable that a situation should be allowed to arise which tended, however gradually, to set up a national relay network as a substitute for the present scheme of broadcasting by wireless. A relay system could never cover the whole country, and only a proportion of the country economically. To reduce the number of our broadcasting stations or curtail their coverage would seriously affect British prestige in Europe where our stations are so widely listened to. Any weakening of our claims to broadcast channels would result in other countries occupying them permanently.

As a measure of national defence in emergency a Post Office distribution of broadcasting can be justified, but never as a peace-time substitute for our present organisation.

Heat Dissipation

By R. H. WALLACE

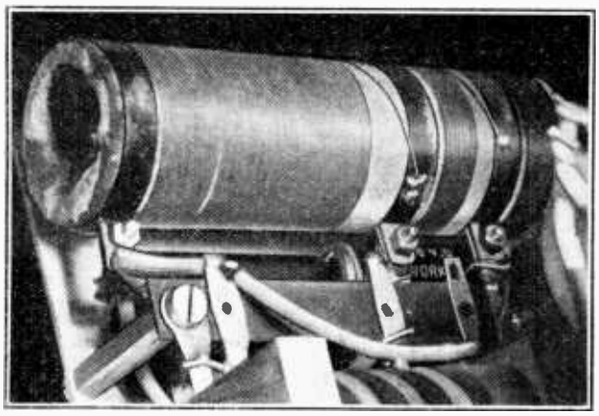
A NEGLECTED ASPECT OF DESIGN

A somewhat disquieting thought is that even quite a modest broadcast set generates enough heat in an hour to boil three pints of water. Precautions for ensuring the rapid and harmless dissipation of this unwanted but unavoidable by-product are discussed, and it is pointed out that worth-while economies may often be effected by proper design and layout.

IT is the author's intention in this article to cover some of the practical considerations of design which are often overlooked in the building of apparatus. In these matters the manufacturer exposes himself to criticism less often than the amateur, but even he, in preparing a design, often neglects points of importance which only come to his notice when service troubles begin. It is not always realised that only a part of the making of a design is finished when the circuit and its values are chosen, and that the carrying out of these into practice with a suitable choice and disposition of components, requires at least as much, often more, knowledge and thought than the preparation of the original plan.

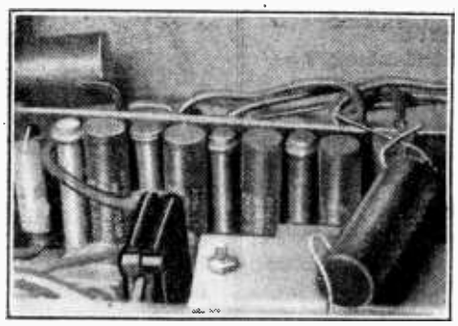
As an engineer himself, the writer has often been appalled by the complete lack of thought sometimes shown in this direction, and the component manufacturer must often be blamed for faults brought about by subjecting his products to improper and unfair treatment.

The point to be dealt with in this article, as it seems to be the most often neglected, will be that of the heating of components and sets; this is, of course, a factor which only affects the most powerful of battery sets, but is of great importance in mains sets, PA equipment and car radio receivers.



This voltage-dropping resistance, wound on asbestos and so obviously intended to run hot, was nevertheless mounted within half an inch of two paper condensers—which actually broke down in service.

The energy supplied to the apparatus is dissipated in two ways only, first as heat in the valves, resistances and other parts, including that developed in the speech coil of the speaker; secondly, as sound energy radiated from the speaker—the latter a very small proportion indeed of the whole, as the efficiency is low and the amount initially supplied only a few watts. It is evident then that practically the whole of the energy taken by the set is released in the form of heat which must be dissipated in some way or other into the surrounding air. It may be interesting to point out that an average set consuming, say 80 watts, will generate enough heat in an hour to boil three pints of water, not that it is suggested that a set would last long if it was so badly designed that it ran at boiling point, but that represents the amount of heat that has to be got rid of somehow.



A fruitful source of trouble: condensers and resistances sandwiched together.

Now when a component is designed it is given a rating which is intended to cover average conditions. The more one pays as a rule the more conservatively rated is the article and the more abuse it will stand without failure; hence if one is somewhat uncertain of the conditions it is better to pay a little more and be on the safe side. The rating in general is based on two factors, the voltage the part will have to withstand, and the current it will have to carry; the latter is that factor which controls the heating and which will be considered now.

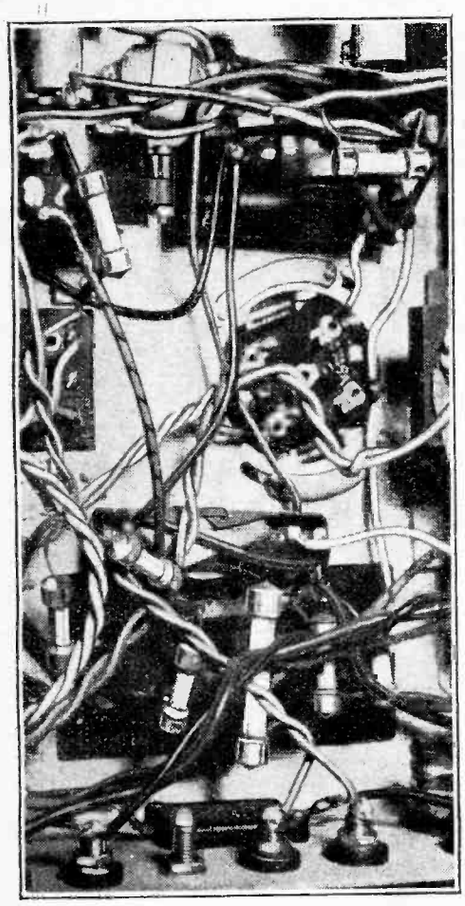
The effect of passing a current through any substance is to release an amount of heat proportional to the watts expended—that is to the square of the current, and the only way that the heat generated can be reduced is by reducing the current or the resistance. The latter is obviously not possible in such cases as that of a fixed resistance, and can only be attained in the case of chokes and transformers at an increased cost, while the former is usually fixed by the valves selected and is irreducible. It follows then that, in general, the only way to reduce the running temperature of a component to a safe value is by getting rid of the heat necessarily developed more rapidly, and thus preserving a lower temperature.

Now without going deeply into the physics of heat it must be mentioned that heat can be dissipated in one of three ways; by conduction to some body in direct contact; by convection to the surrounding air; and by radiation into space, which is independent both of contact and of the air and can take place as well in a vacuum. These three methods are all dependent upon the nature of the surface of the article, and the disposition of the component with respect to other parts, and to access of cooling air, so far as the loss by convection is concerned. A metal base is excellent for conducting the heat away from the cores of transformers and chokes, but for components where the heated element is insulated from the chassis conduction cannot be relied on, as almost all insulators are poor conductors of heat, and convection and radiation alone will be useful.

Obviously, the best way to increase the amount of heat lost by convection is to supply a free current of cool air which can flow past the component. Since heated air rises, there will also have to be free egress for this air somewhere above. The radiated heat is dependent only on the nature of the surface of the article, a dull surface radiates more freely than a bright one of the same temperature and a black one more than a light-coloured one; the worst thing to do is to enclose the part in a highly polished metal container. Naturally, a shrouded article will run at a higher temperature than one not shrouded, other things being equal, but a closely fitting cover of a dull black may actually improve the cooling of a part originally light-coloured.

Free Heat Dissipation

It is unfortunate that the chief considerations in marketing an attractive product are in direct opposition to the requirements for free heat dissipation. The "stripped" manufacturers type of component will run much cooler than a similar article enclosed in a brightly cellulosed, or worse still lacquered metal case.



The resistors of this old-type set may not look so neat as the modern strip-mounted assembly, but they are better spaced.

The best type of resistance for cool running of the element itself are the ones with the resistance wire wound on the outside of a former, preferably hollow, and only lightly coated with enamel, as the wire is in practically direct contact with the air; those enclosed in insulated tubes must run at a higher temperature.

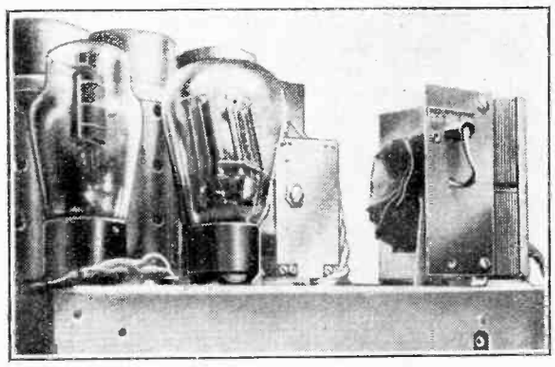
The neatest and most attractive way to mount resistances in the set is on a multiple board where all the elements are grouped together, and while this has much to commend it on grounds of rigidity and neatness it does have the effect of concentrating a great deal of the heat in one place; in order to ensure cool working the board should be carefully placed, and suitably designed. If the resistor unit is horizontally mounted, a slot, or holes, should be cut in it so as to afford ready access of air to the middle, which is the hottest part, and it should not be placed too close to the baseboard or chassis. The modern fashion of housing most of the small parts under a metal base has its advantages in so far as the appearance of the set is enhanced and the collection of dust prevented, but holes should be provided in the base near the hottest places so that the warmed air can rise through and also at the side or underneath so that cool air can enter. If these precautions are not taken, early failure of some of the resistances may be expected.

Special consideration should be given to the voltage-dropping resistance of AC/DC sets. This may easily absorb 40 watts, as much as an electric soldering iron, so the need for care is evident. It should be mounted at least 4in. from any other component, preferably at the back of the set and in such a position that ventilating holes can be provided both above and below it. If it is on a tubular former a slight inclination from the horizontal will be better than any other position, as it will encourage the air to flow through the tube and considerably increase the cooling. A vertical position would do the same, but it would lessen the cooling from the outside, as air heated by flowing past the lower portion of the resistance would not be so effective in cooling the upper part.

Power Valve Precautions

The valves give out quite a considerable amount of heat, especially the output valves and the rectifier—a single "5-watt" triode will dissipate some 25 watts in the anode circuit in addition to the 8 watts of the filament, so it will be obvious that no other part susceptible to heat should be placed above a valve where the stream of hot air will impinge upon it. It is wise, if the valves are placed in a row, as they are in so many receivers, to leave ample space around those which are most heavily rated; for reasons dealt with later on they should not be very near the reservoir and decoupling condensers.

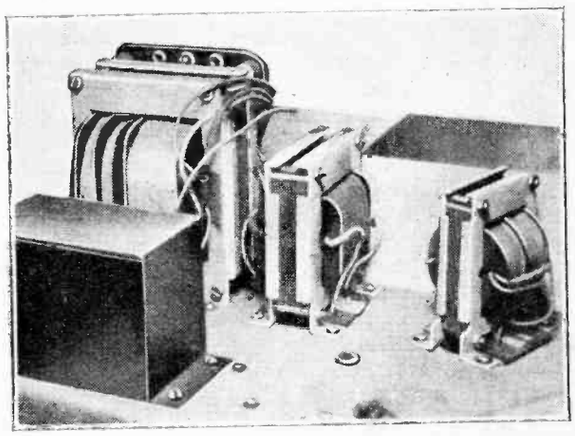
Mains transformers and power chokes are better left unshrouded unless the shrouding has holes for the ingress and egress of air. Nearly all transformer breakdowns are due to excessive heating of the windings through overloading from some cause and an adequate supply of cool air will permit several more watts to be drawn from the windings in safety. As an illustration of this it might be interesting to mention that the large transformers in power stations are often provided with fans which are switched on when any overload occurs and which, by virtue of the increase in cooling thus provided, enable the transformer to carry safely overloads of 100 per cent., and a much less costly construction to be employed



Points in the layout of a modern chassis: the transformer is isolated, while it and those valves which dissipate most energy are at the rear, close to the cooling slots in the back cover.

Condensers, if perfect, would consume no energy, since the current through them is completely out of phase with the applied voltage, the only loss in practical examples occurs due to the losses in the dielectric, which do appear in the end as heat, but except for transmitting gear the heating due to this cause may be neglected.

There is another factor to be considered in the case of condensers and that is their reaction to external heat from the other components. The Mansbridge type is usually made up with paper impregnated with paraffin-wax, the melting point of which is 120 deg. F. and in a very warm situation this will liquefy and may even partly run out. Care should, therefore, be taken in the disposition of these components with respect to such warm neighbours as voltage-dropping resistances and valves. Electrolytic condensers, even those of the nominally "dry" variety, contain some moisture, on the retention of which their functioning depends; their life is, therefore, considerably extended if they are kept in a cool place, even if they do appear to be hermetically sealed.



Provision for free circulation of air: the smoothing condenser block is well separated from the power transformer and smoothing choke.

The field windings of energised speakers absorb anything from 3 watts to 20 watts, but here there is not so much a danger of the wire burning out, as of excessive heat warping the speech coil former and causing it to rub against the poles, with consequent loss of quality; this fault is often difficult to trace as it may not occur until as much as an hour after switching on. It can be avoided by sufficient cooling of the energising coil, and for this reason the author considers it inadvisable to cover the speaker with a fabric bag as is so often done.

The various components being correctly disposed and provided with adequate cooling, it is essential that the precautions taken are not vitiated by boxing the whole up in a small, hermetically sealed cabinet. Fabric backing does normally permit a sufficiently free circulation of air,

Heat Dissipation—

and unless the cabinet is of unusually large dimensions, ventilation holes should be provided both at the top and the bottom of the back. These holes can be covered with the perforated metal or gauze, or the cover may be a metal plate with louvres, which in the opinion of the writer is better, as there is less resistance to the flow of air and also less likelihood of dust getting into the set.

It is not suggested that the above considerations are the only ones that need attention, or that all the modifying factors have been taken into account. The smaller the output of the set or amplifier, the less harmful will be neglect of the correct principles, but careful and thoughtful adherence to the essentials will give a longer trouble-free life to the apparatus, and will often enable a considerable saving in cost to be made by using components of a lower nominal rating than would otherwise be desirable.

How Many Knobs ?

FLEXIBILITY VERSUS ALL-AUTOMATIC CONTROL

By "CATHODE RAY"

IN my perusal of papers wholly or partly devoted to radio I seem just lately to be constantly coming across arguments in favour of the "Big Set." And rightly so. During the last year or two there has been such a tendency for broadcast receivers to become more or less standardised as a superhet with about four valves—selling a bit cheaper each season, and put into a slightly different cabinet, but otherwise much the same—that it is quite possible for the non-technical listener to be unaware that there is anything better. Or if the high-priced models are put before him he may be very doubtful about what he really stands to gain for the extra money.

So it has been pointed out by various writers that the better all-round performance, the effortless range, the extra facilities that are possible when the designer is given a free hand with the number of valves, make radio something quite different from the experience of those who accept the ordinary mass-produced stuff.

There is hardly any limit to the possible number of valves and features, or to the price. Some sets (American, of course) are listed with more than 25 valves—and that is not for television either. Are they worth having when four will do?

Opposite Policies

Well, of course, that depends a good deal on who is to use the set. In planning an elaborate receiver the designer can adopt either of two opposite policies. He can furnish the user with more and more facilities—knobs for this and that, to give him a very large amount of control over reception, or he can assume that the user is utterly incapable of tuning the simplest set properly, and devote thought and ingenuity to making it work itself. Some time ago I quoted an American paper in these words: "It is a foregone conclusion that if radio receivers are ever to be high-quality musical instruments, all controls having any effect whatever upon the tone quality must be kept out of reach of the user." That is one basis for design.

Most of the "features" of a receiver can be allocated to one or other of these two general classes. Take tuning. The flexible, hand-operated, multi-knob set has a subsidiary band-spread tuning control or device for opening out the more interesting parts of the scale and permitting very precise adjustment. The automatic, mini-knob set has ATC for pulling the tuning out of the ham-fist of the clumsy operator into exactly the right adjustment. Take selectivity. The multi-knob set has variable selectivity, which requires the operator to use his judgment according to the prevailing conditions. The automatic type of set has (or would have) ASC for causing the selectivity to depend on the strength of station being received, or (better still) on the interference actually existing. And so on. One type of set looks very complicated but actually is fairly simple; the other looks absurdly simple but actually is fiendishly complicated.

I should feel insulted, of course, if I were offered a "foolproof" set. Yet I may say that, after a bout of the multi-knob type, it is sometimes rather a relief to use one that is just switched on and off and holds no temptation to fiddle about with the controls, trying to get reception a little better. Instead of settling down to enjoy the programme (which with such a set ought to be enjoyable, if it ever can be) one is constantly wondering whether a little less bass-lift or a little more volume expansion wouldn't improve it. That just shows how much depends on the person the receiver is for; some people are much more interested in trying to get the best results than in listening to them after they have got them. And for all I know there may be other people who can concentrate on the programme even though they have a dozen knobs within reach.

There is another reason why the people who are to use the set must be taken into very big account when contemplating a multi-knob set. Although its capability for turning out good results is, assuming competent design, exceptionally great, its possibilities for evil are also exceptional. When operated by somebody who understands what he is doing, it can make the best of whatever conditions prevail with regard to such things as fading, noise, studio acoustics, and "balance and control" by the broadcasters. But in the hands of the unskilful the probability is very heavily loaded against results even as good as those given by the common four-valver. The all-automatic receiver on the other hand, again assuming competent design, may not be capable of quite such favourable adjustments as the hand-controlled set, but is generally incapable of really bad results—until it goes wrong.

"You pay your penny (very figuratively speaking) and you take your choice." So far as ready-made sets are concerned, there is at the moment regrettably little choice, but the same principle holds good for the home-made equipment. If the rest of the family (who, intelligent enough no doubt in their own several ways, are incurable idiots when it comes to radio) have no alternative apparatus suited to their limited technical attainments, then the installation of a set resembling the console of the B.B.C. Theatre Organ is likely to cause the ears of the enthusiastic designer to be assaulted by the most deplorable sounds when the other people lay their hands on it. So if he must have flexible control it should be under cover somewhere, with a simple switch to change over to reliable, if mediocre, performance.

Flexible or Automatic ?

I have often thought of writing about "The Set I Never Have Time to Build." So far I have never had time to think it out definitely enough to write about it. Just as it is beginning to take form in the imagination, some new development or idea makes it obsolete. One of the involved problems is whether to make it an all-"A-C" set or Theatre Organ set. I had the Theatre Organ explained to me once by one of its designers, and, although it would require a very special type of brain to remember everything about it, I did gather that it is possible for combinations of stops to be "pre-set" by somebody who knows all about it, and then, when the time comes for actual playing, the organist does not have to break into the middle of a piece with "Stand by, please, while I change a few dozen stops!" He just touches one button that brings into action the combination that has previously been set up. This seems to suggest a possible solution of the expert-cum-family receiver problem.

I started off with the intention of discussing the relative desirability of the various features that might be included in a big set. But it looks as if that will have to stand over till another time.

Collins Wireless Diary, 1938.—Pp. 146 and diary section. Numerous diagrams. Collins Clear Type Press, London and Glasgow. Price 1s. 3d. to 7s., according to cover.

Preceding the diary proper are 146 pages containing wavelength tables and a great deal of useful technical and other information.

Linear Contrast Expansion

METHODS OF VARYING SOUND INTENSITIES

THE object of contrast expansion is to introduce into the reproduction either of broadcasting or of gramophone records a wider range in intensity than otherwise would be possible. Various methods are reviewed in this article and a detailed description is given of a system using a multi-electrode valve the amplification of which is regulated according to the intensity of the applied signal.

By K. A. MACFADYEN, M.Sc.
(Research Laboratories of The General Electric Company)

THE human ear, like the other sense-organs, is capable of registering stimuli of widely differing intensity. On account of this property, the sounds employed for our entertainment and instruction cover so wide a range of loudness that considerable difficulties are encountered when we try to record them or transmit them by radio. It can be shown that the acoustic power received by the audience is ten million times greater during a *fortissimo* orchestral passage than it is during a solo by a muted violin. The reader will be familiar with the influence of extraneous noise—such as the roar of traffic—on the appreciation of the music by the audience. The quiet passages are lost or badly mutilated. In such a case the conductor of the orchestra is justified in avoiding the use of extremely soft tones.

An exactly similar state of affairs exists in the reproduction of sounds by gramophone or radio. Unwanted noise of a more or less continuous kind (hum, hiss, etc.) is unavoidably introduced both in transmission and reception, in recording and reproduction, with the result that the range of loudness allowable in the large concert hall would be quite unacceptable in a recorded or transmitted programme. Assuming the loud passages to be reproduced at the proper intensity, we should find the quiet passages swamped in noises arising from the recorder and reproducer, or transmitter and receiver (as the case may be), not to mention the noises emanating from interfering stations, atmospheric discharges and from the occupants of the listening-room.

The engineer overcomes this difficulty by arranging for a high gain in the transmitter during soft music and reducing this gain as the sound becomes more intense, thus providing us with a kind of "compressed" range of loudness. The chief objection to this procedure, as the listener to broadcasts from public concerts well knows, is the abnormal prominence given to the unwanted noises from the hall or studio itself. The advantages of listening to such a "compressed" programme are best appreciated by imagining what it would be like to dispense with "contrast reduction" at the recording on transmitting stage.

Thus, assuming that we had a really powerful output stage and speaker, which could re-create in the listening-room the original loudness experienced in the concert hall, we should find the *pianissimo* passages drowned in the manner already described. Let us now imagine the output stage and speaker replaced by components of more modest size, such as most of us employ. Overloading during loud passages would force us to turn down the volume-control, and we should then find the general level of the music disappointingly low.

Again, if one uses music as a "background" for conversation it is clearly disconcerting to have the loudness varying over a wide range. Thus, from many points of view there are advantages in the "compression" apart from the obvious one of avoiding the mutilation of soft passages.

The careful listener does not use music as a background for conversation, neither does he listen in a noisy room if it can be avoided. Moreover, we must assume that the recreation of the original loudness is not precluded by reason of a small amplifier, or on the grounds of domestic politics. The conditions are then favourable for the employment of contrast-expansion. This consists in the use of an amplifier whose gain increases with the volume of the music. In this way, the quiet passages, recorded or transmitted at an unnaturally high level, are restored, at least partially, to their proper level in relation to the loud passages.

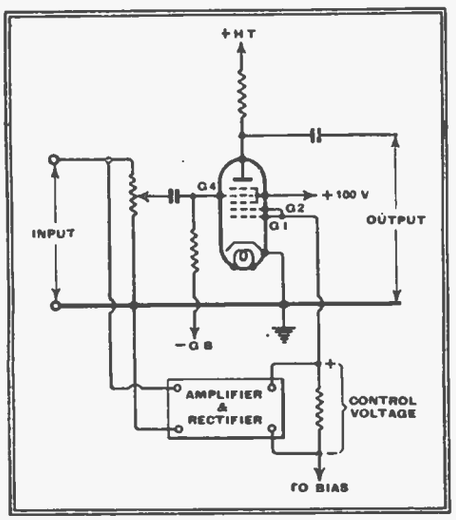


Fig. 1.—Heptode valve employed as an amplifier for contrast expansion. The control voltage increases with the input level and raises gain of the valve by reducing initial negative bias on the inner grids G1 and G2.

Before the various difficulties of this process are discussed, it is desirable to make a brief review of the methods employed. Probably the most perfect method is to use two variable-mu valves in push-pull and to control the bias by means of a DC voltage derived from the input terminals by rectification. A fixed bias maintains low gain when the signal is weak, but as this latter increases, the rectifier provides an additional bias in the positive direction, thus raising the amplification and helping to restore the proper contrast. This method suffers from the drawback of being rather costly.

Another successful method makes use of a heptode. This valve may be employed as an amplifier with variable gain by applying the signal to the fourth grid and a DC "control-voltage" to the first and second grids. The remaining grids act as screens, and the anode-circuit is loaded with a coupling resistance as usual. The control-voltage is obtained from a small rectifier-circuit energised from the input terminals. A schematic circuit is shown in Fig. 1.

Gramophone Reproduction

The third method of producing contrast expansion utilises the fact that a lamp-filament has a very much higher resistance when hot than when cold. By connecting small flash-lamp bulbs suitably in the loud speaker circuit, a certain degree of contrast expansion is obtainable. The main advantage is cheapness.

A very little experimenting is required to demonstrate that contrast expansion has its pitfalls. In the first place, it is found almost impossible to secure satisfactory expansion of radio programmes. With the reproduction of records, however, a considerable degree of contrast may be added with pleasing results. This is fortunate, because the degree of "compression" used in recording is considerable, due to the necessity for avoiding breakdown between adjacent grooves and at the same time keeping the surface-noise inconspicuous.

Linear Contrast Expansion—

Even though the technique is confined to the reproduction of recorded music, however, we soon find that highly exaggerated and unnatural results are obtained unless certain conditions are fulfilled. It is necessary to enquire into the behaviour of the ear in order to understand what these conditions are.

The perception of the loudness of a sound is characterised by our ability to distinguish a change of about 20 per cent. in the power of the sound, no matter whether the latter is high or low, soft or loud. This has led scientists to estimate changes in loudness logarithmically. Thus, a ratio of 10 to 1 in power is called a change in level of 10 decibels. (The logarithm of 10 is 1, but the unit of loudness is taken as one-tenth of this logarithm.)

Amplifier Characteristic

The advantage of this system can be seen from the following example. In all parts of a concert hall the power-ratio of the loudest and softest sounds is the same, but the occupant of a stall hears the music at a higher average intensity than is experienced by a man in the back row. Both experience a *range* of, say, 70 decibels, but in the one case this range may extend from 30 to 100 units, in the other case it will perhaps be from 20 to 90 units of intensity.

We may regard an ordinary amplifier (loosely, it is true) as a device which raises the strength of all input signals by the same number of units. The range of loudness will be unaltered, just as it is by the hearer's proximity to the orchestra. It is convenient to use the word *level* for this idea of average intensity. One may thus hear the same concert at a great many different *levels*.

The ordinary amplifier, then, has a constant gain (represented by the dotted straight line in figure 2), but, as we have seen, for contrast expansion we require one with varying gain. Experiment has established that the gain ought to be proportional to the input—that is to say, the characteristic must still be straight but must lie at an angle, as shown in figure 2.

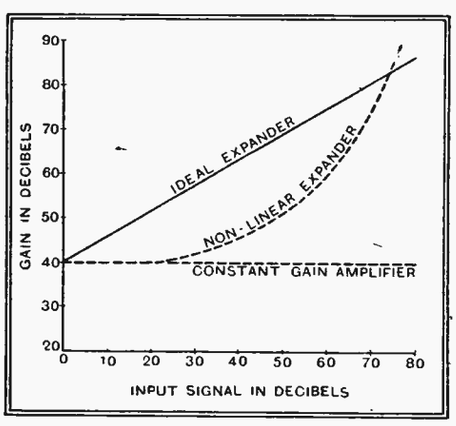


Fig. 2.—The ideal contrast expander should have a linear characteristic as shown by the full-line curve. The two broken-line curves show respectively that of a linear amplifier and of a non-linear contrast expander.

It is this requirement of a straight-line characteristic which is one of the major difficulties of contrast expansion. If the characteristic is curved, as in the dotted curve figure 2, loud passages will be heard to burst forth in a totally unnatural way.

Another requirement is that the slope of this line should be variable at will. This is necessary because not all recordings possess the same degree of "compression." The range of orchestral music is compressed from about 70 to about 30 decibels, while certain chamber music is compressed very little. Evidently the use of an expansion circuit with this type of record would be absurd.

These two requirements—linearity and control—are difficult to satisfy with the cheap and simple lamp-circuit mentioned in the earlier part of this article. The circuit to be described in a forthcoming issue will incorporate special features to ensure linearity and to provide a smooth control of the degree of expansion.

A consideration of any of the expansion circuits described will show that their range of action must be limited. The gain cannot increase indefinitely as the loudness increases. Also it will be clear that the gain will not fall to zero in the absence of any signal. In practice, the best that can be done is to obtain a characteristic with a sufficiently long straight part (see figure 3). An input range of 30 db. is adequate.

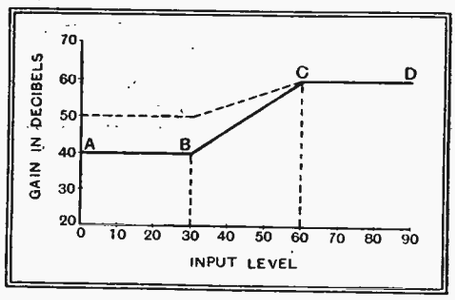


Fig. 3.—For correct operation of the expander the level of the input signal should lie substantially within the region of varying gain represented by B.C.

It is important to ensure that the level of the input signals lies substantially within the region of varying gain, B.C. (figure 3). If the input level is very low, the rectifier will not generate an appreciable DC voltage and the amplifier will operate on the constant-gain region, A.B. Similarly if the input-level is too high, even the weakest signal will cause a big enough control-voltage to elicit the maximum gain from the heptode (or variable-mu valve). This state of affairs is represented in the region C.D.—a region of constant gain.

There is no reason, however, why this limitation in level should be considered to apply to the voltage on the signal grid. Provided that the level applied to the rectifier is correct we may, if we wish, reduce the level at the signal grid to any value—to avoid valve distortion, for example. This control, however, must not extend to the rectifier-circuit (see figure 1).

From what we have seen of the limitations inherent in the circuits it will be evident that we cannot control the degree of expansion (i.e., the slope of the operating region of the characteristic, figure 3) by merely inserting a volume-control before the rectifier. Such an arrangement (although recommended by a number of American writers) merely reduces the level of the signal at the rectifier so as to cause the range of applied signals to cover part of A.B. and part of C.D. (figure 3)—a most unsatisfactory result.

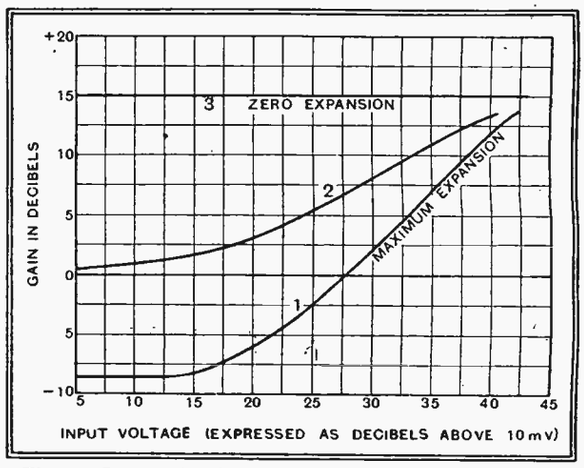


Fig. 4.—Curves showing performance of heptode contrast expander with three different initial voltages on G1 and G2.

In the circuit to be described later control is exerted by varying the initial bias applied to the first and second grids. It has been found experimentally that this can be arranged to give a smooth control, as shown in the curves of figure 4.

In order to avoid distortion, it is necessary to smooth the output of the rectifier before applying it (as a control voltage) to the variable-gain valve. This inevitably introduces a time-lag into the operation of the expander. The lag is not necessarily a disadvantage, for without it slight and rapid changes in the intensity of a note, changes which are not "compressed" in the recording, are exaggerated unnaturally. A *tremolo*, for example, can be made to sound quite absurd in the absence of time-lag. On the other hand, if the time of recovery is too great, not only will there be a sluggishness in the attack of a loud chord, but also at the end of a heavy passage, the needle-scratch when reproducing gramophone records will be heard to die away slowly during the ensuing pause. The optimum time-lag may best be found by experiment.

(*A constructional unit, based on the design recommended in this article, will be described in next week's issue. A list of the component parts to be used will be found on another page.*)

Listeners' Guide for the Week

Outstanding Broadcasts at Home and Abroad

ST. GEORGE'S HALL, in Langham Place and within a stone's throw of Broadcasting House, has, during the seventy years of its existence, been the scene of many and varied kinds of entertainment. Leslie Baily has collected an enormous amount of interesting material about this famous hall for his broadcast "Entertainment at St. George's, 1867-1937," which will be given Nationally on Friday at 8 and Regionally on Saturday at 4.

As all listeners will know, St. George's Hall is now the home of the B.B.C. Variety Department. When opened in 1867 it was the London Academy of Music, and then the German Reed Entertainments were there from 1874-1895. From 1905-1933, when it was taken over by the B.B.C., it was the home of the famous Maskelyne and Devant's magic and mystery shows. During the ten years from 1895 it was used for theatrical productions, opera, lectures and amateur dramatics.

During the programme, which will be produced by Charles Brewer, several people associated with the hall will be heard taking part. The voice of David Devant, the famous illusionist, will be heard, introduced by Jasper Maskelyne, who will act as compère. Devant will not, however, be present in the studio, as he is in the Royal Home for Incurables at Putney. The B.B.C. recording van recently visited the Home, and from his bed the seventy-year-old magician gave his message which will be broadcast in the programme.

Leslie Baily has had a big job in compiling this reconstruction of the history of this famous hall, for no complete records have been kept.

A FAMILY OF SINGERS

FOLK SONGS are always interesting, for in a peculiar way they bring to the hearer something of the life and customs of the people of the country represented. A programme of German and Tyrolese folk songs will be broadcast from the National station on Wednesday at 5.30 by the Trapp Singers of Salzburg. This choir is drawn from one family, and consists of the leader, Captain Georg von Trapp, his wife, five daughters and two sons. They have not previously been heard from an English station, although they have frequently broadcast for the Vienna Broadcasting Corporation, and this year appeared at the Salzburg Festival.

SURMOUNTED by the blue flag of the B.B.C., St. George's Hall is here seen between the pillars of All Souls' Church, Langham Place

SEA FEATURES

LISTENERS to the National transmitter on Sunday evening will hear two broadcasts the theme of which is the sea. At 6.15 a stirring and exciting story of the sea by "Taffrail" will be heard. His subject is an incident which, though of no historical importance, is just as exciting as his programmes on the *Emden* and the Battle of Jutland.

In March, 1899, in the small but dangerous harbour of Apia, in the Island of Samoa, lay at anchor three American and three German vessels and H.M.S. *Calliope*, a steam composite-built corvette of 2,700 tons. The harbour itself is nothing more than a bottle-necked pocket in the knife-edged coral reefs about 800 yards long, with an entrance of only 500 yards.

By midnight on March 15th a full gale was blowing with a furious sea, and by the following morning this had given place to a hurricane. The ships were tossed about like corks in their pitifully small anchorage, many of them being dashed against each other or against the reefs. There came a moment when the captain of the *Calliope* had to face the fact that the only possible hope of escape was to take the ship to sea. That she escaped, although it took more than two hours to cover the first 800 yards, was due to a display of seamanship that has probably never been equalled.

The second programme of the sea will be heard at 10.5. This is "Music from the Sea," a play specially written for the microphone by that eminent poet and author, Walter de la Mare. He has a curious affinity for the medium of broadcasting, as was demonstrated by the adaptations of his "Henry Brocken" and "Yes and Back Again," which, although not written for broadcasting, needed a minimum of alteration in order to make them good listening.

The play depends for its typically cerie atmosphere of mystery and suspense entirely on sound, on music and the music from the sea heard by inhabitants of a lonely and desolate mansion. The composer of the music for this play is Armstrong Gibbs, a close personal friend of the author.

STANELLI'S BACHELOR PARTY

MILLIONS of listeners have heard this party during their thirteen previous broadcasts, and thousands have seen them on the music-halls, but there are one or two interesting innovations in the next edition which will be heard Nationally at 9.20 tonight (Thursday). Stanelli, mine host, heads the bill, supported by the original members: Norman Long, Al and Bob Harvey, and Russell and Marconi. Leslie Hutchinson, the famous "Hutch" of the music-halls, and the Singing Bricklayer, Bruce Brown, one of Carroll Levis's recent discoveries, appear for the first time.

The usual idea will be adopted, namely, that Stanelli, left alone in his house, decides to ask in a few friends to a musical evening, and each in turn

HIGHLIGHTS OF THE WEEK

THURSDAY, DECEMBER 2nd.

Nat., 7.40, Dancing Through: Geraldo and his Orchestra. 9.20, Stanelli's Bachelor Party.

Reg., 6, "Kybosh of Kedgeree"; oriental burlesque. 8.15, Royal Philharmonic Society's Concert at the Queen's Hall.

Abroad.

Rome (No. 1), 8, "Mignon" (Thomas), relayed from the Municipal Theatre, Bologna

FRIDAY, DECEMBER 3rd.

Nat., 7.30, Pianoforte recital: Alexandre Tcherepnin. 8, Entertainment at St. George's, 1867–1937.

Reg., 8, Act I of Puccini's "Il Tabarro" from Sadler's Wells.

Abroad.

Hilversum (No. 1), 8.40, Excerpts from Johann Strauss' "The Gypsy Baron."

SATURDAY, DECEMBER 4th.

Nat., 8, Music Hall. 9.35, The Croydon Philharmonic Society's Concert from Croydon.

Reg., 4, Entertainment at St. George's, 1867–1937. 8.30, "Benighted," from the novel by J. B. Priestley.

Abroad.

Milan, 8, Zandonai's opera, "La farsa amorosa."

SUNDAY, DECEMBER 5th.

Nat., 5.20, Robert Maas ('cello) and Marcel Maas (piano). 6.15, "The Escape of the *Calliope*," by Taffrail. 10.5, "Music from the Sea," by Walter de la Mare.

Sunday, December 5th (*continued*)

Reg., 6.30, Eighth Sunday Orchestral Concert. 9.5, Centenary of the birth of Emil Waldteufel, the famous waltz writer.

Abroad.

Munich, 6.10, Bizet's "The Pearl Fishers."

MONDAY, DECEMBER 6th.

Nat., 8.30, Broadway Matinée. 10, Experimental Hour—3: scene from "Twelfth Night."

Reg., 6, Harry Engleman's Quintet. 8, Joe Loss and his band.

Abroad.

Strasbourg, 8.30, Gala St. Nicholas Evening.

TUESDAY, DECEMBER 7th.

Nat., 8, White Coons. 10.10, Recital: Albert Sammons (violin) and William Murdoch (piano).

Reg., 2.5, Oxford *v.* Cambridge Rugger Match. 8.20, Act II of Lortzing's "Zar und Zimmerman." 9.5, Jack Payne with his band.

Abroad.

Hilversum (No. 1), 8, Concert of Dutch Music.

WEDNESDAY DECEMBER 8th.

Nat., 5.30, The Trapp Singers of Salzburg. 6.40, From the London Theatre—5: "The School for Scandal." 8.15, Symphony Concert from the Queen's Hall.

Reg., 8.15, Carroll Levis and his Discoveries.

Abroad.

Vienna and Munich, 6.35, Haydn's oratorio, "The Creation."

Listeners' Guide for the Week—

contributes to the musical bill of fare.

RUSSIAN AND CHINESE

ALEXANDRE TCHEREPNIN, the distinguished Russian composer and pianist, will give a pianoforte recital on Friday at 7.30 (Nat.) which will include works by himself and by three modern Chinese composers. Tcherepnin has of recent years lived in China, where he has made a special study of modern Chinese music.

One of his ballets, "Le pavillon d'Arminde," will be heard from Leipzig on the same evening at 7.45. He is the son of Nicolai Tcherepnin who was also a great composer and pianist; in fact their works are often confused. Before Alexandre was 25 (he is now 36) he had between thirty and forty works of distinction to his credit.

OPERA

THE postponed relay of the first act of Lortzing's "Zar und Zimmerman" from the Berlin State Opera will be heard on Tuesday at 8.30 (Reg.). Few will need reminding that this opera is based on the life of Peter the Great—Tsar and Carpenter.

Zandonai is one of the very excellent Italian opera composers who has decided to "go with the times" and to give his best gifts to light opera, operetta and even the films. His greatest work is "Francesca da Rimini." His comparatively new "La farsa amorosa" will be heard from the Municipal Theatre, Bologna, relayed by Milan, on Saturday and from Rome No. 1 on Tuesday, on both occasions at 8.

That singularly well-suited opera for broadcasting, Bizet's "The Pearl Fishers," comes from Munich on Sunday at 6.10.

Tuesday brings something new in French opera from Paris PTT at 8.30, "La Ribaude" (The Ribald Woman) by Jean Sablon. On Wednesday at 8 Milan relays from the Royal Opera, Rome, Verdi's "Il Trovatore."

MONGOLIAN

ALTHOUGH the commentary will be in Danish, a broadcast from the Danish stations on Wednesday at 6.30 should be of interest to some listeners for it will include recordings of Mongolian songs and music. These were made by Henning Haslund Christensen, the Danish partner of the famous Swedish explorer of Mongolia, Sven Hedin. Mr. Christensen took with him on his travels through Tibet recording equipment, and he has obtained some unique examples of Mongolian music.

THE AUDITOR.

Broadcast Brevities

NEWS FROM PORTLAND PLACE

Do Empire Listeners Want Music?

IS it the dubious quality of short-wave transmission over long distances that makes Empire listeners apparently unmusical? Music appreciations are negligible in number, and the Empire mailbag shows that even Big Ben—which has some claim to musicianship—has gone down from first place to third.

Most popular of all items to Daventry listeners is now the news.

Enjoying the Announcements

Second in popularity are the four Empire announcers, headed by W. G. M. Shewen, who, despite distances involved, put over their personalities more powerfully than their colleagues at home.

Empire announcing, of course, has a more intimate touch than the home product.

Even talks receive more votes than music. The most popular speaker during the past three months was Howard Marshall.

The Favoured Wavelength

The best all-round wavelength seems to be 19 metres, which gets glowing praise both from South Africa and Australia. During October listeners in Natal heard Daventry on this waveband at local-station strength.

In Sydney they are pleading for 19-metre transmissions from Daventry during the evening. Apparently both Berlin and Paris "romp in" on this waveband."

WHAT NEXT? It is not a floral tea-cosy but the latest camouflage for an N.B.C. portable transmitter. Used for social functions, the only visible sign that it is a complete transmitter is the aerial which protrudes from the top

Has Penmon Failed?

A FORTNIGHT ago we referred to the complaints from Wales of the poor reception in certain districts of the Penmon transmissions.

Complaints continue to pour in from the Welsh coastal towns, notably Aberystwyth and Pwllheli, and in consequence a team of B.B.C. engineers may shortly set out with field strength measuring apparatus for a tour of the country.

Not What the Doctor Ordered

Along the north coast from Llandudno to Rhyl reception is excellent and it is rather ironical that the English-speaking populations of these towns are getting the Welsh transmissions which are primarily intended for, but fail to reach, the dyed-in-the-wool Welshmen in the mountains.

If the B.B.C. engineers discover on this projected tour that conditions are as bad as they are painted, another relay station may be erected in the centre of the country.

Ether Policeman Televised

M. RAYMOND BRAILLARD, Chief of the U.I.R. wavelength-checking centre at Brussels, paid the B.B.C. a pretty compliment the other evening in his talk during television's "Picture Page" from Alexandra Palace. "Your stations," he said, "never need policing."

Interviewed before the camera by Cecil Madden, editor of "Picture Page," M. Braillard showed two frequency charts. One of them, which looked like a "Snakes and Ladders" board, revealed at a glance the wavelength situation in 1927, just before the Prague Plan came into action. The other—a set of almost parallel lines—showed how efficiently the U.I.R. polices the ether to-day.

Ticked Off by Telegram

If a station shows any tendency to stray a letter is sent to the engineer-in-charge, and if no improvement results a telegram follows immediately.

More than 800 wavelength measurements are carried out at Brussels every night, so the engineers have little time to enjoy the programmes.

Behind the Scenes

M. Braillard displayed his interest in television by paying two visits to Alexandra Palace, exploring the transmitters and control room while the station was in operation. Before he left he assured the engineers that they were keeping strictly to their allotted frequencies.

One day M. Braillard may be keeping a check on the world's television wavelengths. The idea is not far-fetched when one remembers that in Cape Town the 7-metre sound signal from Alexandra Palace is picked up almost nightly.

Brave Project

WOMEN broadcasters, with rare exceptions, have not dared to encroach on men's preserves, or to tender advice on how men should go about such tasks as repairing a car or mending a wireless set.

But in the New Year, so the rumour goes, a series of talks will begin in which men will give advice to women.

This is playing with fire.

Major Murray and the Americans

MAJOR GLADSTONE MURRAY, who left the B.B.C. two years ago to become Director-General of the Canadian Broadcasting Corporation, has lost no time in establishing friendly relations with the American networks. In fact, two of his stations—CBM and CBF, both in Montreal — have become affiliated with the American National Broadcasting Company. The former station carries the "Red" network programmes to the French- and English-speaking Canadians of Quebec. CBF, which takes the "Blue" network programmes, is a new 50-kW transmitter which opened only a fortnight ago.

Practical Over-modulation Preventer

A COMPRESSION SCHEME FOR TRANSMITTERS

By W. N. WEEDEN

OVER-MODULATION of broadcast transmitters has been a serious problem, as no operator can control or compress the sudden instantaneous programme peaks in time to prevent them from causing distortion and interference. An automatic system for preventing over-modulation, therefore, would seem an important contribution to the art of broadcasting.

A system of this nature has been recently announced by the Western Electric Company under the name "110-A Program Amplifier, and is intended for use in high-quality broadcast transmitters.

While this programme amplifier has met with a great deal of success in its field tests, it would seem to leave room for improvement, as it acts more as a "limiter" than as a true volume compressor, being so delayed that it effects no change on the input-output characteristics of the transmitter until some predetermined depth of modulation (generally 60 to 80 per cent.) is reached. As the input signal increases above this point, the new "automatic monitor" introduces automatically graduated compression, or limiting, which makes it almost impossible to overload or over-modulate the transmitter, and, even then, the over-modulation will hardly exceed 10 per cent. regardless of the input.

The operation of the W.E. Program Amplifier is best illustrated by Fig. 1, which graph indicates the relationship between the output and input levels of this device for a steady state signal of single frequency. It will be seen that up to the level marked "A" the relationship is linear. For input levels less than "A" the network acts as though it were a small fixed loss, and hence will not affect the character of the programme. However, when the level "A" is exceeded, the network inserts additional loss in an amount dependent upon the increase in programme level, and the volume range beyond the level "A" will therefore be compressed.

Due to the variable loss characteristic of the amplifier, programme peaks at its input which greatly exceed the level "A" will not cause appreciable over-modulation. When the system is adjusted in the prescribed manner, the average programme level will be sufficiently below the "A" level to provide an ample margin of safety so as to prevent normal programme dynamics from placing it in the compression range.

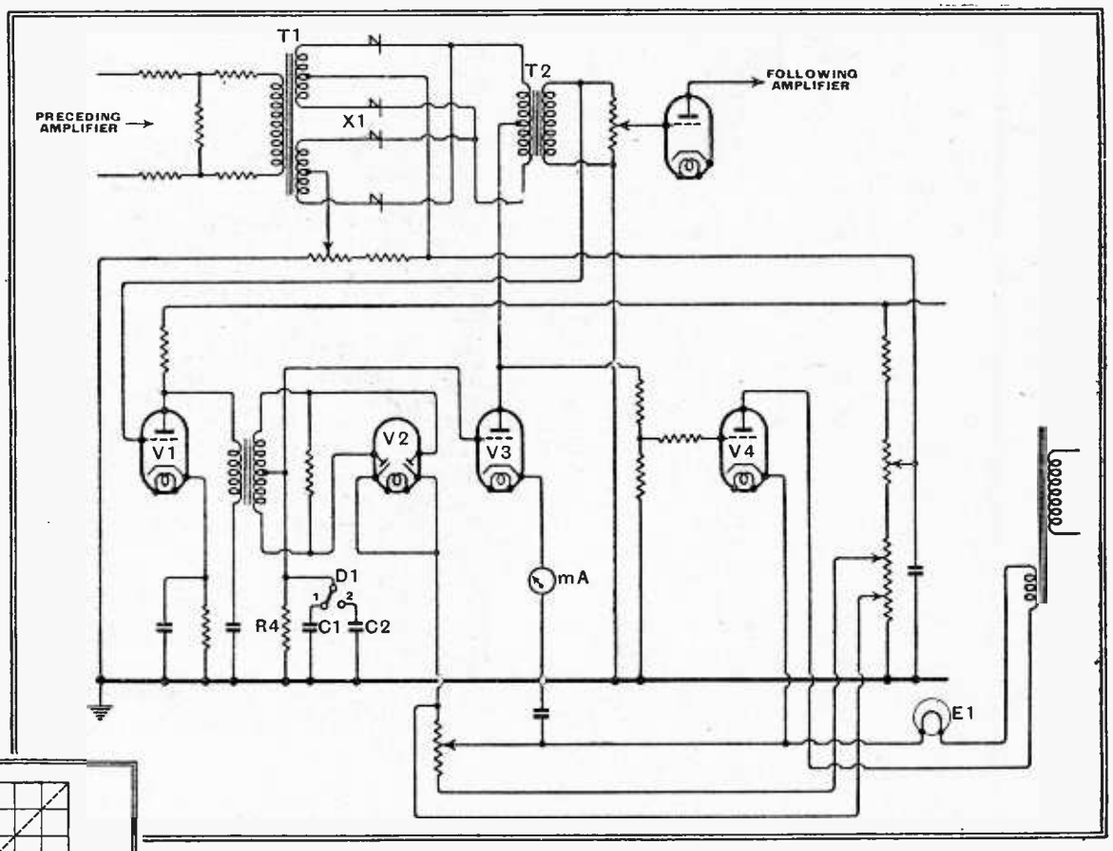


Fig. 2.—The circuit diagram of the compressor is shown here. Compression is actually carried out by the non-linear elements X1.

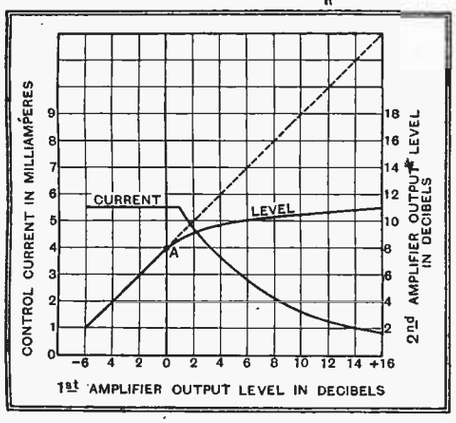


Fig. 1.—The dotted curve shows the response with the linear modulation arrangements usually adopted. The solid line curve shows the compression obtained on deep modulation.

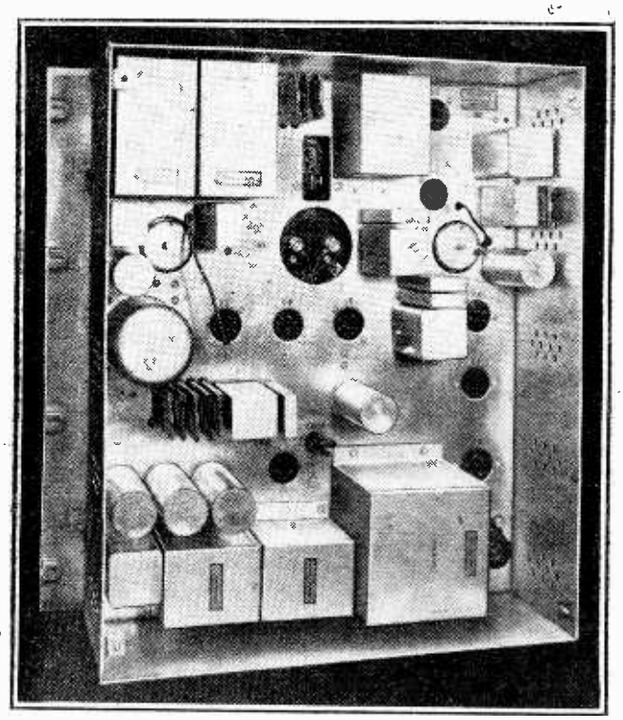
As an example of its use in connection with a broadcast transmitter, suppose that when the instantaneous programme level reaches the level "A" the transmitter is modulated 80 per cent. To reach 100 per cent. modulation of the transmitter, the level at the output of the amplifier must rise about 2 db., and to effect this increase the level, at its input, must rise about 6 db. The difference of 4 db. represents the amount by which the average programme level can be raised by the use of the programme amplifier.

In addition, because the relationship between the number and the duration of peaks and the average programme level varies widely, a lamp is provided to flash whenever the peaks exceed some predetermined level. This flashing-lamp indicator may be set to operate at any level equal to or greater than the level "A." If it has been decided to compress only the upper 6 db. of the volume range, as in the example, then the indicator

Practical Overmodulation Preventer—

would be set to flash at an input level 6 db. higher than the level "A." So long as the lamp flashes infrequently the operator can feel assured that the desired operating condition is being maintained. If the lamp flashes at frequent intervals, it is an indication that the normal peaks are being compressed more than the predetermined 6 db., and adjustments in level should be made.

The essential arrangement of the apparatus is shown in Fig. 2, and the basic part is a network which compresses a definite portion of the programme volume range. The units shown on the diagram as X1 are Varistors (a term coined by the Bell System to denote an element whose resistance changes markedly with either voltage or polarity—as the copper-oxide rectifier and the carborundum resistance employed as X1 in this unit. Thyrite is a third material of this nature), the resistance of which is a function of the voltage to which they are subjected. As will be seen, each side of the balanced network contains one Varistor in series and one in shunt connection. This arrangement maintains the terminating impedances at fixed values while varying the loss through the network. The loss through this network is controlled by a DC potential applied in the manner to be described in the following paragraphs.



A rear view of the compressor with the cover removed.

How the Compressor Works

The transformers T1 and T2 are used to introduce the DC control potential, as well as to obtain impedance matching between the units X1 and the preceding and following circuits. Connected across the programme circuit, at the output of transformer T2 is an amplifier V1, followed by a full-wave rectifier V2. Across the load circuit of this rectifier (R4-C1-C2) a DC potential will be generated, which is related to the programme level at the output of transformer T2. The return circuit from the cathode of V2 includes a biasing potential. Its function is to prevent rectifying action at all programme levels below a pre-selected value, for which levels, therefore, the potential across R4 will remain zero. The network (R4-C1-C2) is included in the grid circuit of the control valve V3, the plate load of which is the Varistor network X1.

For programme levels below that needed to overcome the rectifier bias, the grid bias for valve V3 (potential across R4) is zero, and the division of the anode supply voltage between X1 and the internal impedance of V3 remains fixed. For this condition the loss through X1 amounts to about 4 db. As the programme level at the output of T2 increases sufficiently to overcome the bias on V2, the grid of V3 will receive a bias which is a function of the *excess* programme level. The bias increases the internal anode impedance of V3, thus decreasing the potential across X1 and increasing the loss in the programme path. The relationship between the programme level at the input of transformer T1 and that at the output of T2 is indicated in Fig. 1. The point "A" corresponds to that input level whose rectified component is just equal to the bias on V2.

As the overall frequency characteristic should be flat within narrow limits from 30 to 10,000 cycles, it is necessary to prevent the variable loss network from following the cyclic variation in level at low frequencies. This is accomplished by shunting the resistor R4 by a condenser of suitable size, so that the action of the amplifier becomes more nearly syllabic. Too rapid insertion or removal of loss would also give an unpleasant effect on peaks of very short duration. The constants of R4 and its shunt condenser are selected as a compromise to give an insertion time of about 20 milliseconds and a removal time of 250 milliseconds for position 1 on the diagram (the normal position of switch D1). To provide for those users who desire slightly faster operation, position 2 will give operation intervals of about one-half those in position 1. To indicate visually the conditions of operation, a relay valve V4 is connected in parallel with the Varistors X1. This valve receives a variable bias which permits its breakdown potential to be adjusted to any level equal to or higher than that corresponding to the level "A." In the anode circuit of V4, the lamp E1 will light whenever the bias on V4 is exceeded. By observing the flashes of E1, the operator can determine how frequently and for how long periods the inserted loss acts at any level.

News from the Clubs

Bideford and District Short-wave Society

Headquarters: Mignonette Walk, Bideford.
Hon. Sec.: Mr. W. G. Cough, Glen Gardens, Bideford.

At the second annual dinner several prominent transmitters were among the guests, as well as members of the Torrington Radio Society. The Society has decided to procure a Stentorian loud speaker.

Southend and District Radio and Scientific Society

Hon. Sec.: Mr. F. S. Adams, Chippenham, Eastern Avenue, Southend-on-Sea.

At a recent lecture entitled "Some Interesting Applications of Piezo-electric Crystals" Mr. H. G. Menage, of R. A. Rothermel, Ltd., dealt with various devices such as apparatus for testing the heart, watch-testing gear and mechanism for recording vibrations in car engines.

The DF contest held on November 7th was very successful. The start was from Rayleigh, Essex, and the first competitor to find the hidden transmitter was Mr. G. T. Peck, the second being Mr. K. W. Harbridge. Although this was intended to be the final outdoor meeting of the year, it is understood that a petition has been organised requesting the committee to arrange a further contest as soon as possible.

Southall Radio Society

Headquarters: Southall Library, Osterley Park Road, Southall.
Meetings: Tuesdays at 8.15 p.m.
Hon. Sec.: Mr. H. F. Reeve, 26, Green Drive, Southall.

The recent talk by Mr. H. A. M. Clarke on the "Design of Transmitters" was exceptionally interesting and provoked a large number of questions. On December 7th Mr. H. J. Walters will talk on the "Suppression of Electrical Interference." This lecture is being arranged in co-operation with Messrs. Belling and Lee, Ltd.

Sheffield Short-wave Club

Headquarters: Ebenezer Street, Shalesmoor, Sheffield.
Meetings: Wednesdays at 8 p.m.
Hon. Sec.: Mr. D. H. Tomlin, 32, Moorsyde Avenue, Sheffield, 10.

The Club has now taken over new premises in which special apparatus, including frequency meters, capacity bridges, and other gear is being installed for the use of members. Morse and constructional classes are being held and also a special beginners' class. The subscription is 10s. per annum payable quarterly.

Exeter and District Wireless Society

Headquarters: Y.W.C.A., 3, Dix's Field, Southernhay, Exeter.
Meetings: Mondays at 8 p.m.
Hon. Sec.: Mr. W. Ching, 9, Sivell Place, Heavitree, Exeter.

Atoms, Electrons and Ions formed the subject of a lantern lecture recently given by Mr. V. Searle, M.Sc. The subject was a difficult one, but members were fortunate in having a lecturer who has often proved his skill at making difficult subjects comparatively simple to understand.

Croydon Wireless Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

Members had great difficulty in deciding the merits of the various instruments submitted for test on the recent loud speaker evening. A surprise item was a demonstration of the new Rothermel piezo-electric loud speaker which had a very good response even at 15,000 cycles. Another equally surprising demonstration was the W.B. Planoflex loud speaker.

RANDOM RADIATIONS

By "DIALLIST"

Second-hand Prices

A RECENT leading article in *The Wireless World* on the subject of second-hand prices hits a protruding nail smack on the head. Scores of friends and hundreds of correspondents have told me that they are going to "make do" with the existing receiver if its part-exchange value after a couple of years' use is down to about a quarter of its original price. They know well enough that they'll get much better all-round performance if they go in for a new set or radiogram whose price is about the same as that paid for the existing set. But they can't bring themselves to believe—and frankly I don't blame them—that it is economically sound to let the old set go at what is almost a break-up price when it's still doing pretty well. There are two chief reasons why second-hand sets fetch so little. The first is that the prices of new sets tend to fall, so that you can buy now for perhaps ten pounds very much what you bought for fifteen pounds a couple of years ago. It follows that the man who buys your ex-set assesses its present worth on a ten-pound and not a fifteen-pound basis. The second reason is that a two-year-old set will certainly be in need of several valve replacements, to say the least of it, while it is on the cards that its wave-change switch and its manual volume control have seen their best days. Valves—valves particularly—but other components as well, are pretty costly when you come to buy them as replacements. Hence the buyer of a part-worn set may find himself up against quite a big expenditure if he desires, as probably he will, to have it made as new.

Body Resistance

YOU may remember that some time ago I raised the topic of the resistance of the human body to electric currents, both alternating and direct. One should, perhaps, say zero-frequency current instead of DC but *pace* Mr. Scroggie, DC is good enough for me! Through the kindness of Dr. W. E. Boyd I have just received a reprint of the report which appeared originally in the British Journal of Physical Medicine, on researches which he and Mr. M. R. Gavin conducted over a long period into the impedance of the human body to DC, and low-frequency AC. In the tables embodied in the report the resistance and capacity components of the impedance are shown separately, so that the "R" of the human body at various voltages and various frequencies is made quite clear. In the experiments, I should mention, the two electrodes, cut from the same sheet of aluminium, were placed one on the tum-tum of the subject and the other on his forehead.

Facts and Figures

With both AC and DC it was found that the initial resistance was high. However, it falls very rapidly in the first five minutes and then much more gradually until it levels out after fifteen to twenty minutes of contact. With DC, using an applied potential of 3 volts, the initial resistance was found to be of the order of 3-5 megohms, falling after six minutes to 76,000-1,400,000 ohms, and becoming stable at 222,000-310,000 ohms after twenty minutes. Higher potentials appear to show lower body resistance, as one reader suggested that they might. With AC the initial resistance is very much lower, being 24,000 ohms at 1,000 cycles. It decreases rapidly as the frequency is raised: at 2,000 cycles it is 22,000 ohms, and at 4,000 cycles, 18,000 ohms. The same fall as with DC is observed as time goes on, the biggest part of the drop taking place within the first five minutes. After fourteen minutes the resistance is stable at 8,900 ohms for 1,000 cycles, 4,070 for 2,000, and 2,010 for 4,000.

Wired Television

THE G.P.O. seems to have achieved a considerable measure of success in its experiments on the transmission of television over co-axial cables. It is now reported that distances up to 400 miles can be covered, which is twice as far as has been managed in Germany. But whatever may be the possibilities of using cable as the television link, I, personally, doubt whether televiewers would welcome the development of a single centre in London to serve the whole country with programmes. As I see it, television is not going to achieve real success as a popular hobby until it can enable us regularly to see interesting things as they are occurring. Though the owner of a televisor in the Midlands, the West Country, the North or Scotland would doubtless like to see events of national importance on his viewing screen, such events are comparatively few and far between. Certainly there aren't enough of them occurring in the London area to fill the television "actuality" programmes. For the bulk of your transmissions you'd have to rely on events of much more local interest; the man who lives in some other part of the country would not be content with the London scene alone.

What of the Future?

It is impossible, of course, to say how television will develop as time goes on. I should think, though, that by far the most satisfactory arrangement would be on rather the same lines as those upon which ordinary broadcasting has worked out. Certainly, regional television stations would seem to be necessary to provide the local interest in the programmes. They might be linked up by means of co-axial cables both with London and with relay transmitters in their own areas. They could thus "take" London transmissions when these were of national interest, though otherwise they would rely largely on more or less local matter. A national system, for the provision of an alternative service, might become needful in time, but to begin with a regional service would probably be sufficient by itself.

Getting There by Degrees

I'M not one of those who run down everything British and say that the foreigner is leaving us far behind. Certainly I don't believe that the biggest and best American set is ahead of anything that we can do. Thanks largely to the insistence of *The Wireless World* the British designer is being given a chance this year of showing what he can do if only he is allowed a little rein. In the past, unfortunately, those who call the tune by paying the piper have refused to give our designers their head. They have been tied down, by having to work to narrow production costs, to a small number of valves, and right nobly they have overcome their difficulties. Now at last the British radio manufacturer is realising, though it may be rather dimly, that we also have a luxury market for receiving sets and that there are amongst our people not a few who don't mind paying handsomely for a receiving set that will give something like the best that can be given. This year a fair number of big receiving sets have made their appearance—I am not talking of radiograms—and they will undoubtedly be successful if . . .

That Big If

If only manufacturers will let the public know that such sets are available, and will take every opportunity of showing how well worth-while it is for those who can afford their cost to buy them. I am rather afraid that they'll lack the courage to do so. At one stand which I visited at Radiolympia the only thing that really interested me was a big receiving set containing most modern refinements and priced at a pretty high figure. I couldn't for some time find anyone on the stand who knew very much about it. At length a technician was unearthed who did understand it and its splendid qualities. I was enthusiastic over it. He was distinctly restrained. "We're only making a few," he said, "to see how they go." "You tell the public what you've got," quoth I, "and they'll go for it in a way that'll surprise you." But since the Exhibition I haven't see a single advertisement anywhere extolling the virtues of that very fine set, or even letting the man in the street know that it exists.

On the Short Waves

OCCASIONALLY in contemporary British publications one sees references to the short-wave technique adopted by the American short-wave stations, the "palm" generally and quite erroneously being given to these American stations, the Daventry transmitters being given second place, with no mention of the German equipment at Zeesen at all.

Whilst there is no doubt that the pioneer short-wave broadcaster was KDKA, followed by Schenectady 2XAF-2XAD (no W prefix in those days) and PCJJ Eindhoven, with G5SW Chelmsford fourth, there is equally no doubt that the new Daventry in 1932, with its multi-frequency technique and very flexible twin 10-15 kW transmitters, set a new standard in really scientific world broadcasting.

It must be remembered that in 1932 Zeesen had only one 5 kW. transmitter, DJA, using an omnidirectional aerial, followed later by DJB. The establishment of the German world service did not follow until much later, but they now have eight 40 kW. transmitters available, five being normally used in conjunction with a complicated system of directional arrays to East Asia, South Asia, Africa, S. America, Central America and North America.

The original frequencies notified for use

On the Short Waves—

by Daventry were GSA to GSH, and included at least one frequency in the bands* allotted to short-wave broadcasting at the World Telecommunications Conferences at Washington, 1927, and Madrid, 1932. Subsequently additional frequencies were added, and the B.B.C. now have available some 18 frequencies (according to the Berne List), of which 14 are more or less in regular use. Zeesen has 16 frequencies notified, of which 11 are in general use.

The equipment at Daventry now comprises six transmitters—two of 10 kW, two of 20 kW, and two of 50 kW, the powers mentioned being aerial powers, which, in the case of a 50 kW transmitter, means an input power (total) of between 250 and 300 kW.

More important than the transmitters, however, are the aerial arrays, of which 25 are now in use at Daventry supported by 12 masts varying in height from 500ft. to 150ft., and occupying 150 acres.

There are some six miles of open wire feeder supported on 600 steel poles and a large open-air distribution frame leading to the six-point, six-position transmitter-array selector switches.

Perhaps even more important still than the arrays or the transmitters is the correct selection of frequencies; it must be remembered that the British Empire subtends some 340 degrees (out of 360 degrees) at Daventry, and the most distant point is nearly 12,000 miles away. This problem is taken care of, I understand, by a small group of engineers in Broadcasting House, and free use is made of every phase of modern short-wave technique by this section of the engineering division.

The largest American stations are insignificant when compared with Daventry and Zeesen both in material and technique, and their greatest weakness lies in their failure to provide adequate aerial systems. Modern stacked arrays are used only by Schenectady W2XAF and W2XAD, and, even though in this case the arrays used are not comparable with those of Daventry and Zeesen, most listeners will agree that these two transmitters put up extremely good performances. After Schenectady comes W1XAL Boston, using, I believe, horizontal dipoles, and, after Boston, W2XE of the Columbia system. W2XE uses a single, general-purpose horizontal Vee array, and, as may be expected, puts over a very good signal indeed on the highest frequency used, 21.52 Mc/s, where the efficiency of the aerial is highest. The signals from W2XE on the 15 and 11 Mc/s bands would probably be better, however, if arrays similar to that used by W2XAD were erected.

Finally, we have Boundbrook, W3XAL. This transmitter has also recently changed over to horizontal Vee aerials with reflectors, but one cannot say that the change has met with any success, and, judging by the performance of W1XAL Boston (and W2XAF before midnight), it would appear that a horizontal dipole, erected as high as possible, is the next best aerial to a full-sized array of unit dipoles.

During the week-end of November 19th-21st, conditions were distinctly poor in the evenings, although at times W2XAF had been very good as early as 8 p.m., occasionally interfered with by JZK Tokio, and on some nights W1XAL on 11.79 Mc/s was good also.

In the afternoon, especially on Saturdays and Sundays, W2XE on 21.52 Mc/s continues to give signals of very good entertainment value for long periods, and this station with W2XAD and W1XAL were useful on 15 Mc/s during the early evening up to 7.30 p.m.

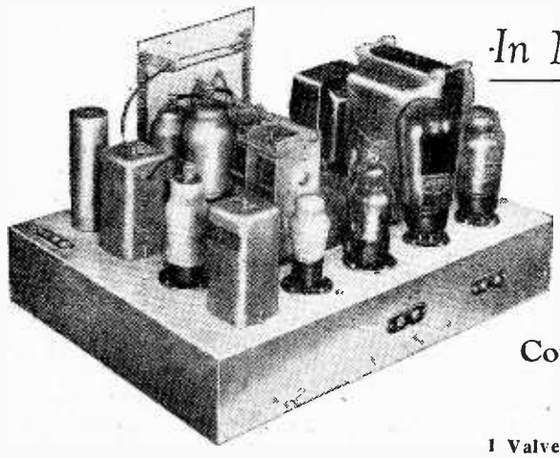
On November 23rd an amazing improvement set in at 9 p.m., and at 10 p.m. W2XAD and the 14 Mc/s U.S. amateurs became good signals.

During this time of the year listeners should concentrate on the daylight frequencies 40-18 Mc/s (8-18 metres) until 6 or 7 p.m., and then tune to the 15 Mc/s band until 9 or 10 p.m., using the 11, 9 and 6 Mc/s bands from 8 p.m. onwards. Stations in the East, however, may be heard on 9 or 6 Mc/s in the afternoons or early evenings, i.e., KZRM Manila on 9.57 Mc/s, HS8PJ Bangkok on 9.51 Mc/s, and VG7LO Nairobi on 6.08 Mc/s.

ETHACOMBER.

* Except the 26 Mc/s or 11 metre band.

In Next Week's Issue



Four-Band Super-Six

AC Superheterodyne Covering Short, Medium and Long Waves

MODERN conditions demand a high degree of selectivity in a receiver. This is generally realised on the medium and long wavebands, but it is often held to be unnecessary on short waves. Actually, however, selectivity is just as important in this part of the tuning range, for short-wave broadcast stations are now powerful and crowded together in their bands.

A high degree of adjacent channel selectivity is obtained in the Four-Band Super-Six by the four efficient tuned circuits in the IF amplifier. These circuits are arranged in two coupled pairs, and the coupling between one pair is adjustable by a switch control to give two degrees of selectivity.

The receiver commences with an RF stage which is followed by a triode-hexode frequency-changer. There is one IF valve and a diode provides detection and non-delayed AVC and is resistance-coupled to a high-gain triode AF amplifier. This valve, in turn, is resistance-coupled to a triode output valve.

Two signal-frequency tuned circuits are used and are in circuit on all wavebands. The four bands cover 10.5—28.5 metres and 27.5—70 metres in addition to the usual medium and long wavebands.

LIST OF PARTS.

1 All-wave tuner — **Sound Sales "Sound Fourband Tuner"**
1 IF transformer, 465 kc/s — **Varley BP122**
1 IF transformer, 465 kc/s, variable-selectivity — **Varley BP124**
1 Mains transformer, Primary: 200-250 volts, 50 c/s. Secondaries: 350-0-350 volts, 120 mA; 4 volts, 2.5 amps.; 4 volts, 1 amp. C.T.; 4 volts, 4 amps. — **Vortexion AC350**
1 Smoothing choke, 20 H, 140 mA. 250 ohms — **Varley DP10**
1 Volume control, tapered, 0.25 megohm (less switch) — **Centralab 72-121**
1 Switch, rotary type, SPDT — **Bulgin S92**
2 Valve holders, 4-pin (without terminals) — **Clix Chassis Mounting Standard Type V1**
1 Valve holder, 5-pin (without terminals) — **Clix Chassis Mounting Standard Type V1**
2 Valve holders, 7-pin (without terminals) — **Clix Chassis Mounting Standard Type V2**

Condensers:
- 1 32 mfds., 320 volts, electrolytic — **T.C.C. 809**
- 1 50 mfds., 12 volts, electrolytic — **Dubilier 3016**
- 1 50 mfds., 50 volts, electrolytic — **Dubilier 3004**
- 1 8-8-8 mfds., 500 volts, electrolytic — **Dubilier 316**
- 3 0.1 mfd., 350 volts, tubular — **Dubilier 4603/S**
- 1 0.01 mfd., 350 volts, tubular — **Dubilier 4601/S**
- 1 0.0003 mfd., 350 volts, tubular — **Dubilier 4601/S**
- 1 0.0001 mfd., 350 volts, tubular — **Dubilier 4601/S**
- 1 0.5 mfd., 350 volts, tubular — **Dubilier 4602/S**

Resistances:

1	50 ohms, ½ watt	Claude Lyons
1	400 ohms, ½ watt	Claude Lyons
1	3,000 ohms, ½ watt	Claude Lyons
2	20,000 ohms, ½ watt	Claude Lyons
1	250,000 ohms, ½ watt	Claude Lyons
1	500,000 ohms, ½ watt	Claude Lyons
1	1 megohm, ½ watt	Claude Lyons
1	2 megohms, ½ watt	Claude Lyons
1	7,500 ohms, 1 watt	Claude Lyons
1	3,500 ohms, 2 watts	Claude Lyons
1	1,000 ohms, 3 watts	Claude Lyons

1 Group resistance board, 5-way — **Bulgin C31**
1 Skeleton captive screw strip, 3-way, A1, A2, E — **Bulgin T11**
1 Skeleton captive screw strip, 2-way, pick-up — **Bulgin T10**
1 Skeleton captive screw strip, 2-way, speaker — **Bulgin T10**
3 Knobs (walnut) — **Bulgin K24**
2 Plug-top valve connectors — **Belling-Lee 1175**
2 Lengths screened sleeving — **Goltone**
Chassis — **B.T.S.**
Miscellaneous: — **Peto-Scott**
4 lengths systoflex; 2 ozs. No. 20 tinned copper wire, etc. Screws: 30 ¼in. 6 BA R/hd.; 8 ¾in. 4 BA R/hd.; 4 ¼in. 4 BA R/hd.; all with nuts and washers.

Valves:
- 1 D41 (Met.), 1 H42, 1 PX4, 1 U12 — **Osram**
- 1 AC/VP2 (Met.) — **Mazda**
- 1 VP4B (Met.), 1 TH4A (Met.) — **Mullard**

Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

Television

AS a mere listener, I am becoming very tired of seeing the same old question in the columns of radio critics—"Why doesn't television catch on?" Either they are extremely dense or they won't see the answer to their parrot-cry. Probably it's a mixture of both!

Perhaps *The Wireless World* will allow me to say a few carefully chosen words on this sore subject. Television doesn't "catch on" because, in the first place, and despite the many assertions to the contrary, *it can never by its nature attain the widespread popularity of sound broadcasting.* People can listen to music while they are engaged in various occupations; they don't have to be glued to their loud speakers to enjoy what's going on. Viewers, on the other hand, are obliged to keep within sight of their television screens to follow a visual programme. That brings me to point number two. Most people are agreed that screens are absurdly small. In the old days of the magic lantern a canvas sheet was hung on a wall in the living-room, being rolled up out of the way when not in use, and, in my opinion, television will never amount to much until something of a similar nature can be done to "amplify" images and scenes. And remember, television is not the novelty that the magic lantern was; in a sense, the cinema has anticipated television.

Prices will, of course, settle themselves, as they did in the case of sound receivers, but the number of valves (taking into account their expense) in many television receivers is preposterous! A final point. The installation of such sets is never the simple matter it can be in the case of sound receivers. T. J. E. WARBURTON.

East Molesey.

American "Equivalents"

I READ "Heptode's" recent letter with great interest. I, too, have a grudge against the valve manufacturer who claims that his "international" valve is equivalent to an American valve. If its characteristics are not the same as the American valve it is not fair to say that it is "equivalent," for it will not be suitable for replacing American valves in a circuit designed for them. If its characteristics are the same, what does the British manufacturer claim as his reason for giving it a different type number? Attempts were once made, and still are in America, to reduce the number of different types, but this is a step in the wrong direction. Perhaps British valves are more durable than the average American valve, but surely there are manufacturers in that country who turn out rather more reliable valves than the average, who do not think it necessary to change the name in order that the public shall know. Perhaps some British manufacturer would like to state his point of view?

Horsham. J. VAUGHAN.

"Direct Current" or "Zero Frequency"

MR. SCROGGIE'S further letter on the above subjects throws a rather different light on his suggestion. I most certainly understood from his previous letter that he wished to abolish entirely the use of the term "direct current." In fact, I got the impression that he could scarcely find printable language strong enough to denounce it. By all means let us use the term "zero frequency" in any circumstances where its use will make the meaning clearer and where the term "direct current" is obviously inapplicable. I should certainly not hesitate to use it myself in such circumstances. Is it not, in fact, already in use to some extent? There can be no objection to abbreviating it where desired to ZF.

The definition of pulsating current given by Mr. Scroggie is, of course, quite accurate and furnishes an instance of the correct use of the term "zero frequency"; but it would not do to refer to pulsating current merely as "ZF current," whereas it certainly comes under the accepted meaning of DC. In other words, DC is a useful general term applicable to unidirectional electrical quantities. ZF would signify a unidirectional unvarying quantity, and when we wish to make it clear that this is what we are referring to, then ZF may be used to advantage in many instances.

Finally, there are instances in which a case can be made out for the use of such terms as "DC current" and "DC voltage." DC should in such cases be regarded merely as a symbol meaning "unidirectional" and not as an abbreviation, although the origin of the symbol was the abbreviation of "direct current."

Liverpool. T. A. LEDWARD.

"Potted" Chimes of Big Ben?

ON Saturday, November 13th, I was listening to the Regional programme. I heard Big Ben strike five o'clock. I then changed over to the National on 261.1 m. No sooner had I tuned in but I heard "This is the National programme," followed by Big Ben again striking the four quarters and one hour, i.e., one o'clock. About thirty seconds later this was repeated, and one o'clock struck for the second time. Another interval of thirty seconds, and Bow Bells then started. These continued till 5.10 p.m., when Henry Hall's signature tune was faded in. Even then Henry Hall himself did not speak until the end of the first "number." All this rather set me wondering if we do ever hear the chimes of Big Ben or if we only hear a recording.

If you consider this of sufficient interest to be inserted in your "Letters to the Editor" section I should rather like to know if any other reader had this rather bewildering experience.

Elstree. J. M. S. ADAMS.

Atmospheric Cross-Modulation

THE article by Mr. W. L. Hafekost in the October 22nd issue is very interesting, but would have been still more interesting, and more illuminating, if the data had been more complete.

In reading the article one is left in some doubt as to the meaning of "signal attenuation" in Table A. Presumably it is the monthly average attenuation of the resultant 2,903 kc/s frequency, but is it relative to the maximum observed value of this frequency or relative to one or the other of the fundamental frequencies?

Although the author mentions the use of a directive loop antenna, the data on direction of arrival of the 2,903 kc/s frequency are not given, and this information should certainly be of great value in determining the source of the inter-modulation.

The presence of inter-modulation presupposes non-linearity somewhere in the transmission path, and if the well-known power series expansion for a non-linear element be used, the 2,903 kc/s frequency is

Television Programmes

An hour's special film transmission intended for the Industry only will be given from 11 a.m. to 12 daily.

Vision	Sound
45 Mc/s.	41.5 Mc/s.

THURSDAY, DECEMBER 2nd.

3, The Habina Theatre. **3.30,** Gaumont-British News. **3.40,** A Pepler Masque on "The Rime of the Ancient Mariner."

9, Amateur Boxing Association Tournaments at Alexandra Palace. **9.30,** British Movietonews. **9.40,** Experiments in Science—6. How human speech is made. **9.55,** Starlight.

FRIDAY, DECEMBER 3rd.

3, The Ballet Rambert in Cross Gartered. **3.20,** British Movietonews. **3.30,** Laurence Olivier in scenes from "Macbeth" from the Old Vic.

9, F. Anstey's famous story "Vice Versa" adapted for television. **9.40,** Gaumont-British News. **9,50,** Artists and their work—3.

SATURDAY, DECEMBER 4th.

3, Punch and Judy. **3.10,** Cartoon Film. **3.15,** Hints on laying out a new garden. **3.30,** Gaumont-British News. **3.40,** Cabaret.

9, Cabaret. **9.30,** British Movietonews. **9.40,** A Pepler Masque on "The Rime of the Ancient Mariner."

MONDAY, DECEMBER 5th.

3-4.30, "Once in a Lifetime": a play by Moss Hart and George Kaufman.

9, Comedian. **9.10,** Hans Falkner, Director of the Ober-Gurgl School in the Tyrol, will show preparatory exercises for ski-ing. **9.20,** British Movietonews. **9.30,** Cabaret.

TUESDAY, DECEMBER 6th.

3, Musical Act. **3.10,** British Movietonews. **3.20,** F. Anstey's "Vice Versa."

9, Speaking Personally—7. **9.10,** Cartoon Film. **9.15,** Starlight: Steve Geray and Magda Kun. **9.30,** Gaumont-British News. **9.40,** The Ballet Rambert in Cross Gartered.

WEDNESDAY, DECEMBER 8th.

3, Ballroom Dancing demonstrated. **3.10,** The Trapp Singers of Salzburg: folk songs of the Tyrol. **3.20,** Gaumont-British News. **3.30,** 101st Edition of Picture Page.

9, Dancing Time. **9.20,** British Movietonews. **9.30,** 102nd edition of Picture Page.

Letters to the Editor—

seen to be due to the cubic term, and is therefore proportional to the first power of the signal intensity of the National transmitter and to the square of the signal intensity of the Regional transmitter, thus accounting for the observation of the greater effect of the Regional transmitter.

Cannot the influence of weather conditions on signal intensity be explained if the signal variation were due to ordinary fading, that is interference between the ground wave and the sky wave? This would appear possible since the illustration at the head of the article shows transmission antennas of a type capable of causing such fading at the 30- or 40-mile distances at which the observation was made.

New York. DUDLEY E. FOSTER,
Radio Corporation of America.

Practical Contrast Expansion

The constructional details of a unit based on the principles described in the article on pages 559 and 560 of this number will be included in next week's issue. The following list indicates the components that have been used for building the unit.

1 Mains transformer, Primary: 200-250 volts, 50 c/s. Secondaries: 300-0-300 volts, 80 mA; 4 volts, 2.5 amps. C.T.; 4 volts, 2.5 amps. C.T. **Rich and Bundy Model No. 5**

1 Smoothing choke 20 H., 50-60 mA **Rich and Bundy Model E122**

Condensers:

2 8-8-8 mfds., 570 volts working, electrolytic **Dubilier 3220**

2 25 mfds., 25 volts, electrolytic **Dubilier 3016**

1 0.5 mfd., 350 volts, tubular **Dubilier 4608/S**

2 0.1 mfd., 350 volts, tubular **Dubilier 4603/S**

1 0.1 mfd., 1,500 volts, oil-immersed **Dubilier 950A**

1 0.02 mfd., 350 volts, mica **Dubilier 680**

1 Volume control, 500 ohms **Haynes Radio**

1 Valve-holder, 4-pin (without terminals) **Clix Chassis Mounting Standard Type V1**

2 Valve holders, 5-pin (without terminals) **Clix Chassis Mounting Standard Type V1**

1 Valve holder, 7-pin, (without terminals) **Clix Chassis Mounting Standard Type V2**

Resistances:

2 350 ohms, ½ watt	**Bulgin HW40**
1 700 ohms, ½ watt	**Bulgin HW41**
2 100,000 ohms, ½ watt	**Bulgin HW25**
1 250,000 ohms, ½ watt	**Bulgin HW28**
2 500,000 ohms, ½ watt	**Bulgin HW31**
2 1 megohm, ½ watt	**Bulgin HW33**
1 5,000 ohms, 1 watt	**Bulgin WE1**
1 20,000 ohms, 1 watt	**Bulgin WE3**
2 3,000 ohms, strip type	**Colvern**
1 3,500 ohms, strip type	**Colvern**

1 Intervalve transformer 1:3.5 **R.I. "Dux" DY29**

1 Volume control, 50,000 ohms **Haynes Radio**

4 Terminals, ebonite shrouded, Output+, —, Pick-up (2) **Belling-Lee "B"**

1 Plug top valve connector **Belling-Lee 1175**

Chassis 13 × 8¾ × 2¼ in. **Haynes Radio**

Miscellaneous: **Peto-Scott**

3 lengths systoflex, small quantity No. 16 and No. 20 tinned copper wire, piece paxolin 6 × 2in. for resistance board, 6 rubber grommets. Screws: 36 ¼in. 6 BA R/hd; 10 ½in. 6 BA R/hd; 8 ½in. 4 BA R/hd; 4 ¾in. 4 BA with ⅜in. spacing collars; 1 1¼in. 6 BA, all with nuts and washers.

Valves:

1 MH4, 1 D41, 1 MX40, 1 U12 **Osram**

WIRELESS BATTERIES IN THE MAKING

THE manufacture of dry batteries is a very important branch of the wireless industry, and the modern method of production entails a high degree of mechanisation, automatic machinery of a specialised nature being necessary to cope with the very big demand for all types.

Few, perhaps, realise the many processes and the care that has to be exercised in production to ensure the long working life that is one of the outstanding features of the modern HT battery.

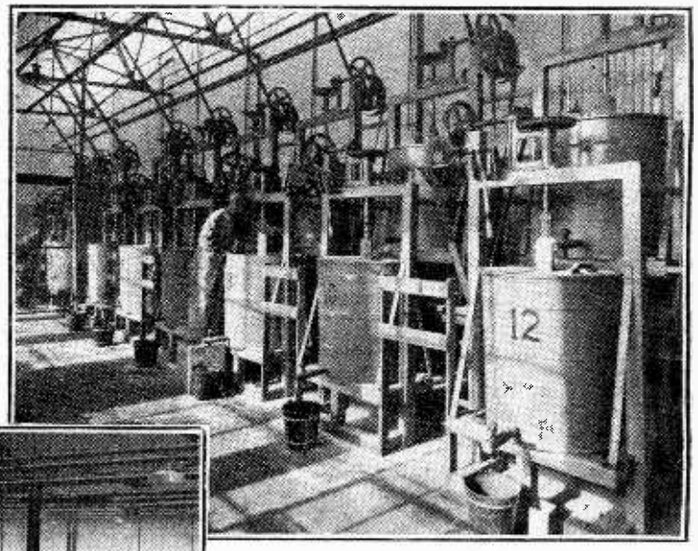
By the courtesy of the General Electric Co., Ltd., we were recently afforded facilities to visit their extensive battery works at Witton, Birmingham, which now occupy nearly 100,000 square feet of floor space.

The layout of the factory is on modern lines, raw material being received at one end of the building and, after the various processes, the finished product, in the form of HT, grid bias and dry-cell batteries of all sizes and types, is delivered ready packed for despatch at the other end.

Reduced to its simplest form, a single dry-cell, irrespective of size, consists of a tightly compressed mixture of manganese dioxide and graphite with a carbon rod in the centre. This depolarising block, or dolly, as it is generally described, is wrapped in muslin and then placed in a zinc container from which it is separated by the electrolyte made up in the form of a paste.

Regular routine tests are carried out at various stages in order to ensure uniformity, for one cell in a 120-volt battery, which, incidentally, contains 80 separate cells, if below a predetermined standard would shorten the working life of that battery.

Automatic machines make the dollies, wrap them and take them through the various processes to form the complete cell. At this stage, where the individual cells are first capable of showing a voltage, they are tested, and then, if to be used for HT or grid-bias batteries, they are passed through a machine which solders on to the zinc case a short length of connecting wire. The small sockets for the tappings on the batteries are, however, soldered on by hand. This is one of the few hand processes in the production of this class of battery in the G.E.C. works.



The electrolyte mixing machines in the G.E.C. battery works are seen to the right, and below part of the final assembly and packing shops.

Next, the cells are assembled in cardboard boxes divided into the requisite number of compartments and the cells are interconnected to form a complete battery. Further voltage tests are made, and, finally, a bitumastic compound is poured over the top to seal the battery. It is then labelled, wrapped and packed ready for despatch.

Actually, the manufacture of dry batteries is much more involved than this brief description implies, and there are many more processes than those mentioned.

Mechanisation tends to convey an impression of simplicity, since one machine alone may be passing the article through several different stages in its production.

New Apparatus Reviewed

Recent Products of the Manufacturers

HUNT'S ALL-WAVE SIGNAL GENERATOR

MADE by A. H. Hunt, Ltd., Bendon Valley, Garratt Lane, Wandsworth, London, S.W.18, for servicing and general testing this signal generator is designed to provide a signal, either modulated or unmodulated, on all wavelengths covered by the modern broadcast receiver.

It has a waverange of 10 to 3,000 metres on fundamental frequencies, and this band

Compact battery-operated all-wave signal generator made by A. H. Hunt.

is covered in five ranges selected by a switch.

The tuning dial of the RF oscillator has five separate scales calibrated in metres which for normal servicing work is probably more convenient than having to refer to charts and then setting the dial to the appropriate position.

It is stated, however, that the scale calibrations are approximate only, but we found them to be sufficiently accurate for normal requirements. If greater accuracy is needed reference can be made to a chart which gives the actual waverange of each band, and this chart is calibrated for each instrument.

Though the highest fundamental frequency is 30 Mc/s (10 metres) signals can be obtained on higher frequencies by utilising the second harmonics of Range 1, which will thus provide a signal for testing sets on the television wavelengths. This harmonic range covers 5 to 15 metres.

Internal modulation at about 400 c/s is generated by a separate valve, and the output from this oscillator can, if required, be used for testing AF amplifiers and similar equipment. Its output is controlled by a separate attenuator.

Control of the RF output is effected by a six-position step attenuator giving 1, 10 and 100 micro-volts and 1, 10 and 100 millivolts output respectively. A high level RF output not controlled by the attenuator is also available should it be needed.

Tests have been made on all ranges, and nowhere did we find the calibration to differ from that of a laboratory standard signal generator by much more than 1.5 per cent. The average discrepancy was appreciably less than this, and it can be said that the accuracy of calibration is quite adequate for all normal testing purposes. It is definitely good for this class of instrument, for it is not a laboratory standard model but an inexpensive serviceman's test set.

Though precautions have been taken to totally enclose the oscillator in a metal case, a little RF leakage was noticed on the short-wave ranges with the result that the RF attenuator did not take complete control at the very low output levels. The difference between 1, 10 and 100 microvolts was less marked than one would expect it to be. It should be stated, however, that this is only noticeable when testing very sensitive receivers.

RF leakage is very difficult to avoid at the high frequencies, and complete immunity can only be obtained by very elaborate screening, and consequently adds enormously to the cost of the unit.

The Hunt's signal generator is battery operated and quite self-contained. It is small, light in weight, and complete with a dummy aerial covering all wavelengths costs £12 12s.

WEBB'S RADIO GLOBE

THIS globe has been prepared especially for amateur wireless experimenters as it gives certain information of particular value not readily obtained from other sources.

The most important is the division of the globe into radio Continental areas as recognised by the International Amateur Radio Union for the issue of WAC (worked all continents) certificates.

Should any doubt arise concerning the exact classification on this basis of, say, a certain group of isolated islands reference to the Webb's Globe will show in which continent they come. The international amateur prefixes for all countries and districts are also included.

When erecting a directional aerial either for transmission to or reception from a particular part of the world it has to be borne in mind that wireless waves follow a great

The globe prepared by Webb's Radio for the short-wave experimenter.

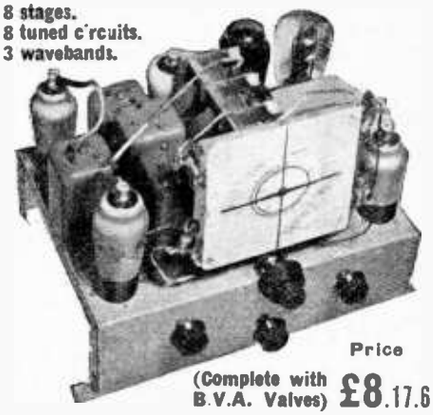
circle path. The necessary information relating to the direction for the aerial is quickly ascertained from the globe.

There is a great deal of detail apart from radio matter, and it should prove very useful to all short-wave experimenters. It measures 12in. in diameter and costs 27s. 6d., which is very reasonable for a globe of this size, particularly as it is a very well-made article. It is obtainable from Webb's Radio, 14, Soho Street, Oxford Street, London, W.1.

McCARTHY

6-valve all-wave Superhet with Radio Frequency Stage

8 stages.
8 tuned circuits.
3 wavebands.



Price (Complete with B.V.A. Valves) £8.17.6

Performance (made possible by use of multi-electrode valves) equal to that of many receivers employing 8 valves or more. Brief specification includes: Large "Airplane" dial, with different coloured lights automatically switched on for each wave-range. Micro-vernier 2-speed drive. 4-point wave-change and gramophone switch. Volume control and variable tone control also operative on gramophone. Reinforced heavy-gauge steel chassis. Covers 19–2,000 metres.

Circuit comprises: Preselector circuit, radio frequency amplifier (operative on all 3 wavebands), triode-hexode frequency changer, double band-pass I.F.T. coupled I.F. amplifier, double diode-triode detector and L.F. amplifier. D.A.V.C. applied to 3 preceding valves. 3-watt pentode output.

9 VALVE FOUR-WAVE SUPERHET DE LUXE

14 GNS.

(Complete with 9 B.V.A. Valves)

4 wavebands: 12.8-33, 29-80, 190-550, 800-2,000 metres. Illuminated dial with principal station names.

Controls.—A feature of the receiver is the number of independent controls fitted, making it extremely interesting to operate. These include sensitivity control (varying bias on R.F stage), or Q.A.V.C. with manual muting control for inter-station noise suppression. 5 position wave-change and gramophone switch. Progressive variable tone control operative on radio and gram.

Circuit in Brief.—Aerial input to pre-selector circuit, radio frequency amplifier, latest type triode-hexode frequency changer, 2 band-pass I.F.T. coupled I.F. amplifiers, double diode detector, triode L.F. amplifier, separate triode phase-changer capacity coupled to 2 large pentodes in push-pull. Heavy 16-gauge steel chassis. Finest components and workmanship throughout. Harries tetrodes in place of output pentodes if desired.

STANDARD MODEL 12 GNS. As above, but with triode push-pull output, and fewer controls fitted

DEFERRED TERMS on application or through our City Agents
LONDON RADIO SUPPLIES LTD.
11, OAT LANE, E.C.2.
Demonstrations Daily.

All McCarthy receivers supplied complete with valves, knobs, pilot lamp, leads, mains cable and plug. 12 months' guarantee. (Valves 3 months.)

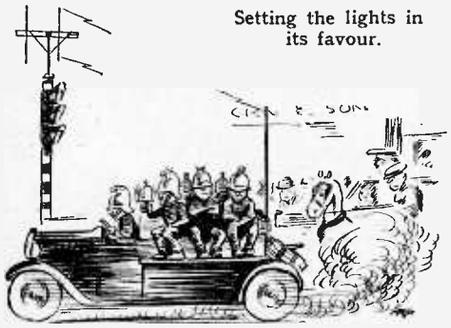
Complete illustrated catalogue, with technical data and circuit diagrams, on receipt of 2d. in stamps, or abridged list of McCarthy chassis types free of charge.

McCARTHY RADIO LTD.
44a, Westbourne Grove, London, W.2
Telephone: Bayswater 3201

UNBIASED

Radio Traffic Lights

A WEEK or two ago I told you about the plans being prepared by a certain foreign country to make broadcast listeners under their control undergo a tuning test before being granted a listening licence. According to one of my correspondents, the Government of the country in question intends to go farther than this, as special courts are to be established, before which listeners will be hauled if



Setting the lights in its favour.

they offend by putting up aerials of the type which are a blot on the landscape, or by letting their loud speakers make a nuisance of themselves.

It is a great pity, I think, that we in this country are so much behind the times in this sort of thing as in others of a like nature. I well recollect being in a certain foreign town some little time ago where the very latest thing in radio traffic control has been installed. The town possessed more or less the same kind of traffic lights as we do over here, but special arrangements had been made so that when a fire engine, ambulance or police car came along, it employed micro-wave beam wireless to set all the lights in its favour.

This was carried out by equipping each of the signal standards with a receiver working on a wavelength of considerably less than one metre. The fire engines, and other vehicles empowered to have a right of way, were each fitted with an automatic transmitter which was left working all the time, as there was no likelihood of interfering with other stations on this lonely wavelength.

A second reason for their radiating all the time was that, owing to the very short wavelength, the range was extremely restricted, and it was not until the vehicle got within a comparatively short distance of the traffic signals that it operated them. All it did was simply to switch the lights in its favour and hold them there until it had passed out of range.

Such a scheme was, of course, a triumph for wireless, since the city fathers had run up against an unexpected snag when they tried out the photo-electric cell method of accomplishing this feat. In this case photo-cells were mounted on top of the traffic standards, and all police cars, etc., were equipped with super-powerful spot lights on their roofs which operated the traffic lights when they were near enough to affect the photo-cells.

Unfortunately, it was found in practice that the range of the light was not nearly great enough, but this was by no means the biggest disadvantage, as local gangsters and other citizens in a hurry simply fitted their own cars with a spotlight. The micro-wave arrangement, however, was completely successful, since it had ample but not too great range, and, of course, the exact wavelength is changed quite frequently before the local lads of the village have time to discover it by trial and error.

All the same, I see no reason why any competent technical man should not devise some sort of DF apparatus to discover quickly the wavelength to which an unknown receiver is tuned, for, after all, this is all it amounts to, and at the moment I am busily engaged upon the problem in my laboratory.

If I attain any measure of success I intend to go across the water and try it out. At the same time, in order to put a check to the lying calumnies which so easily gain credence among the uninstructed public, I had better say here and now that my experiments are *not* being subsidised by any gangster or gangsters. If, therefore, you have any bright technical suggestions to make to me upon the subject, your consciences need not deter you.

Pirates or Parasites?

THERE are, as many of you will probably know, two kinds of wireless piracy, the one we hear most about being the bold, bad type where a listener installs a set without the formality of taking out a licence, and openly defies the P.M.G. to come and get him. Such pirates are moved to their action not so much by a desire to deprive the B.B.C. of payment which is justly due to them for the amusement they provide as by a justifiable "agin-the-Government" feeling which is engendered by the high-handed action of the P.M.G., who uses the various Wireless Telegraphy Acts as a cloak behind which he quietly embezzles money which morally belongs to another; for, after all, when we have dispensed with all the eyewash about the ten shillings being a licence fee, we all know full well that we only consent to pay it because we realise that the programmes must be paid for somehow.

Although they refuse to pay this unjust Government imposition, they all, I feel sure, forward the money privately to the B.B.C. There is, however, a far larger class of people who are a standing disgrace to the honoured name of "pirate"; I prefer to call them parasites, for not only do they refrain from paying their just dues to the B.B.C., but they leave the unfortunate wireless manufacturers to starve, as they do not bother to buy, or otherwise acquire, a wireless set, but batten on their neighbours by listening to theirs.

I should never have known of the existence of this modern form of eavesdropping had it not been for a correspondent of mine on the staff of the B.B.C., who informed me of the growing number of people who write in to complain of the inaccuracy of the time signals. Recently the authorities at the Big House were, I learn, so concerned about it that they instituted an enquiry, only to find that no inaccuracy existed. They were, however,

By FREE GRID

still puzzled by the amazing consistency in the degree of error alleged by the complainants who nearly all accused the B.B.C. of being slow by from 1/50th to 1/20th of a second, or thereabouts.

As has so often been the case in past scientific history, the true explanation proved to be so straightforward and obvious that it had escaped notice. Actually it came to light, owing to the fact that on the list of complainants' names and addresses which my B.B.C. friend gave me, Mrs. Free Grid happened to notice a name she knew well, and immediately announced that the person in question didn't even possess a wireless set. Further investigations by certain methods known only to Scotland Yard and myself revealed the fact that none of the people who had complained of the time signal owned any form of wireless receiver whatever.

Needless to say, after this piece of information had come to light, the solution to the problem was quite simple, and I scarcely like to insult your intelligence by explaining. For the benefit of the weaker brethren among my readers, however, I may point out that if you take your time

Starving wireless manufacturers leaving food kitchen.

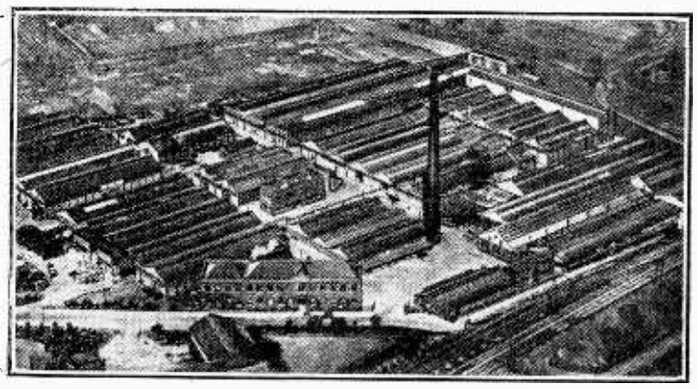
signals from your neighbour's loud speaker there will inevitably be a lag of about 1/20th to 1/50th of a second or so, according to the size of the houses in the district and the exact part of his domicile in which your neighbour keeps his wireless set. People who live in baronial halls are, of course, liable to get the same error in the case of taking the time signal from their own loud speaker, but I hardly think that this will affect many of *my* readers.

Lead Storage Batteries

THE largest plant in the British Empire for manufacturing storage batteries is situated at Clifton Junction, near Manchester, and is owned by the Chloride Electrical Storage Co., Ltd.

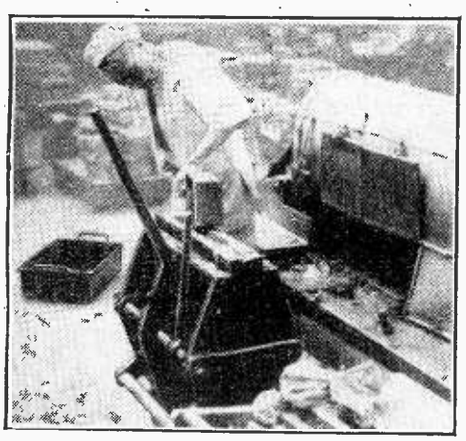
The works and offices of the company occupy nearly 15 acres, and a recent visit provided an opportunity for a tour through the principal buildings, where hundreds and thousands of batteries are continually being produced in a great variety of types to give service in every part of the world.

A Visit to the Exide Works at Clifton Junction



The essential raw materials are lead, antimony and lead oxide, of which thousands of tons a year are converted into batteries.

The visitor is impressed with the ingenuity of the many machines employed in production, many of these machines having been evolved on the premises to simplify processes and speed up manufacture.

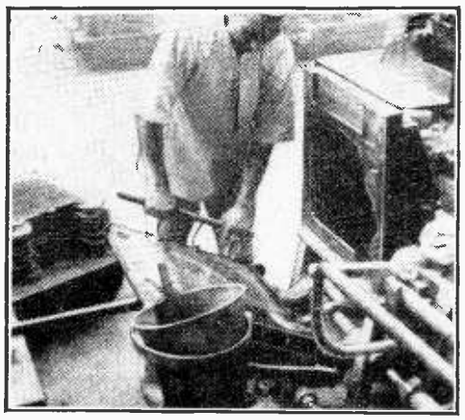


Casting large accumulator plates. The molten metal being poured into the mould.

One of the most interesting departments is that where castings for accumulator plates are produced. The moulds employed are constantly opening to disgorge finished plates and closing again to receive the molten metal, which is poured in, to repeat the process as batch after batch of plates of various types and sizes are moulded. The moulded grids, after finishing and inspection, are next filled with lead oxide in the form of paste, an operation which appears simple enough, but requires long experience and skill to be carried out with the dexterity and accuracy necessary.

It is an impressive sight to see the long rows of batteries in the final stage of being charged ready for service after the plates have been "formed" and the batteries assembled in their many shapes and sizes.

It is impossible to visit the Exide Works without being conscious of the fact that the constant handling of lead on such a scale means that special precautions must be taken to safeguard the health of those engaged in the work. In spite of the fact that it may be generally regarded as a dangerous occupation, so elaborate are the precautions taken to keep the air free from dust and to keep down dust on the floors that it is the proud boast of the company that there have been no cases of illness due to the nature of employment since 1929. The health and welfare of the employees is under the supervision of a whole-time medical officer and staff, and wherever there is the slightest risk that dust might be present in the air specially designed respirators are worn, special clothing is issued, and facilities are provided for baths before changing into normal clothing.



Extracting the plate from the mould.

Service Test Apparatus

WE have received advanced proofs of a new catalogue of service test apparatus and "semi-laboratory" gear compiled by Claude Lyons, Ltd., 40, Buckingham Gate, London, S.W.1, as a supplement to their "J" catalogue of GR apparatus. The list, which is full of most useful technical information, covers a wide range of inexpensive meters, signal generators, wavemeters, oscillographs, bridges, laboratory sundries, and the better class of American valves and photocells. A charge of 1s. post free is made, but this is returnable on the first order to the value of £1. In any case, the wealth of information conveyed in the very complete specifications is well worth the money.

REPUTATION

YOUR 'Buy' WORD

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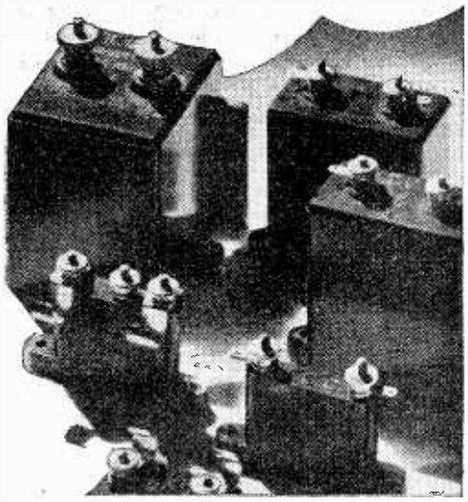
AND with the building up of such an unique experience—second to none, has been built a sound reputation for unswerving dependability of product. That reputation, acknowledged by every discerning setmaker, designer and experimenter throughout the country, is your safeguard. Let it be your 'buy' word. When you need condensers—say T.C.C.



T.C.C.

ALL-BRITISH CONDENSERS

The Telegraph Condenser Co. Ltd., Wales Farm Road, N. Acton, W.3.

3484

Decca "Portrola"

FEATURES. Weight.—*27 lb.* **Wave-ranges.**—*(1) 19-49 metres. (2) 200-550 metres. (3) 1,000-2,000 metres.* **Circuit.** — *Triode-hexode frequency-changer — var.-mu pentode IF amplifier — double-diode second detector — pentode output valve.* **Controls.** — *(1) Tuning. (2) Volume and on-off switch. (3) Waverange. (4) Tone. (5) Motor switch. (6) Mains voltage adjustment.* **Price.**—*16½ guineas.* **Makers.** — *Decca Gramophone Co., Ltd., 1/3, Brixton Road, London, S.W.9*

A COMPACT PORTABLE ALL-WAVE RADIOGRAMOPHONE

We have received a surprising number of requests for details of the performance of this instrument, and it is easy to understand why it has taken so firm a hold on the interest and imagination of the public. In a neat leather-grained case measuring only 17¾ x 13½ x 9in. is packed —if we except television—a slice of every form of entertainment purveyed by the radio industry to-day. It would be unfair to expect as big a helping as is served in the full-sized radiogramophones, but the convenience of portability and, more particularly, the facility with which it can be adapted to any form of mains supply, more than compensates for the lower standard of performance which we must expect.

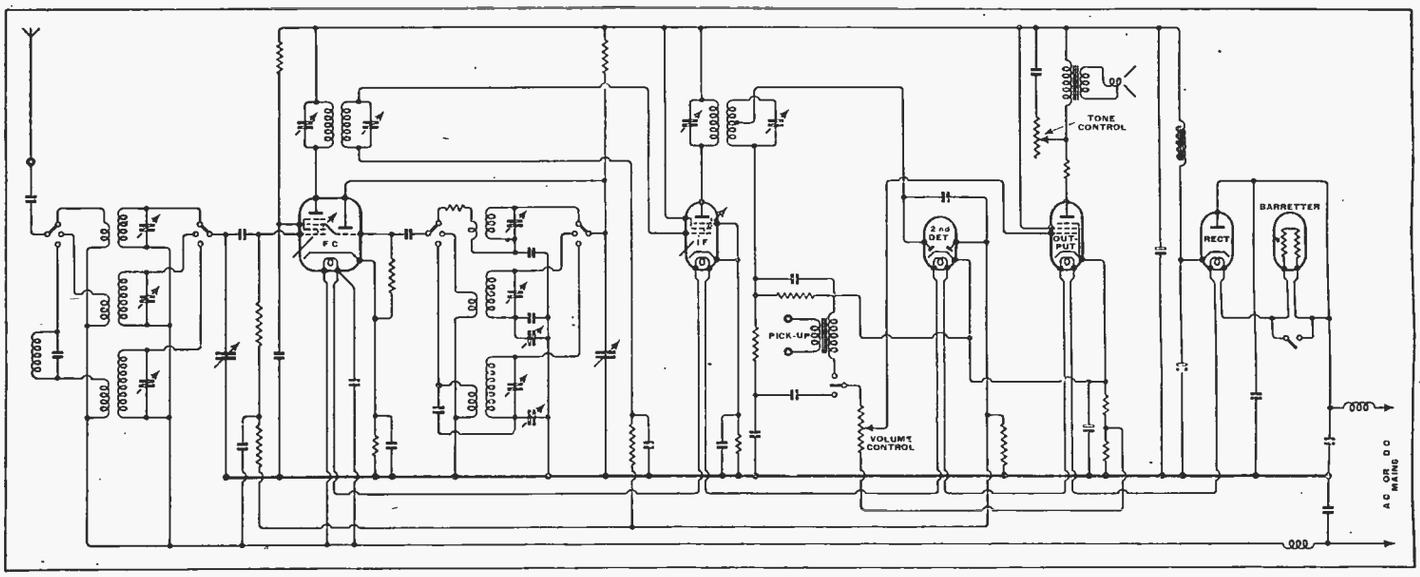
Instead of the usual complicated system of plugs or links in the mains voltage adjustment, a multiple switch with four positions is provided. Thus the instrument can be instantly adjusted for 100-130-volt or 200-250-volt AC or DC supplies. Two sets of contacts are incorporated in the switch, one for adjusting the supply to the receiver chassis and the other for making the appropriate changes in the connections of the windings in the Collaro U36 universal gramophone motor. The mains adjustment is fitted with a standard type of control knob and changing the mains setting presents no more difficulty in operation than the waverange switch. But this very facility introduces the danger that the mains voltage adjustment may be accidentally altered during the course of operating the set and accordingly the makers have fitted the control under the 8-inch turntable which must first be removed.

The motor is suspended on a three-point rubber mounting from a special pressed metal base-plate. This is provided with ventilating louvres and is shaped to accommodate the oval tuning dial of the chassis and the projecting edge of the small permanent-magnet loud speaker which is mounted in the left-hand front corner of the case. The motor is provided with a speed regulator and an automatic switch is incorporated in the pick-up tone arm pivot.

The radio chassis itself is a remarkably compact unit and an example of clever assembly and wiring. The valves are mounted horizontally and are taped to prevent them from working out of their sockets in transit. Even so, reasonable care should be exercised in handling the set to prevent the loosening of the pins and consequent bad contacts.

The absence of a mains transformer has materially contributed to the reduction in size of the chassis. The mains are led through choke filter circuits to a half-wave rectifier, and on 200/250-volt mains the filament current is controlled by a barretter lamp. This is short-circuited for the 100/130-volt range.

The triode-hexode frequency-changer is preceded by a single tuned circuit on each of the three wavebands and a filter is introduced on the long-wave range to prevent break-through from strong medium-wave stations. The variable-mu pentode IF amplifier functions on a frequency of 465 kc/s, and this valve and the frequency-changer are controlled from the AVC line. The connections of the double-diode



The circuit is suitable for operation from AC or DC mains and a mains voltage adjustment switch (not shown) is included for altering the connections of the gramophone motor.

Decca "Portrola"—

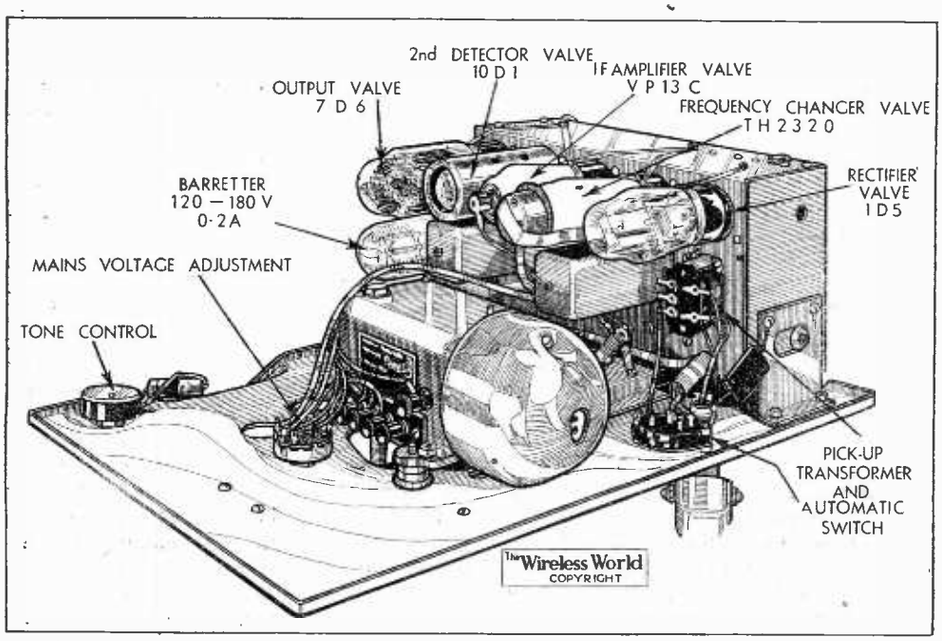
second detector and output valve follow standard practice, but it will be observed that a built-in input transformer has been provided for the pick-up in order to give the isolation necessary in a universal set.

The instructions, which are printed on the back of the circular speed indicator card, refer first to the gramophone side, so that presumably this is regarded as a more important aspect of the performance. The pick-up is lodged on a rest at the back of the turntable and is held down in transit by a piece of sponge rubber attached to the lid. The pick-up must be lifted before even a 10-inch record can be put on the turntable and in doing so the automatic switch is brought into operation and any radio signals which are being received are automatically cut off.

who contemplate a repetition of this performance should note, however, that the station was first received at an outdoor aerial and then transferred without altering the tuning to the smaller aerial.

On a normal outdoor aerial the medium- and long-wave ranges come to life and as many stations are then available as from the average 4-valve table model superheterodyne. They have not, however, quite the same punch, and the omission of the triode stage from the second detector must be regarded as responsible for this.

Tests were made on both DC and AC mains of 230 volts, and while there was evidence of some mains noise on the AC supply, the DC was exceptionally silent. The top-plate warms up after a time from the heat given off by the barretter, but



With the exception of the PM loud speaker the whole of the instrument is assembled on a metal base plate.

For all normal recordings the volume control can be left at maximum, but a reduction may be necessary on the deeper-cut dance records in order to avoid overloading of the three-watt output valve.

As regards quality of reproduction the limitations of all portable types of receiver are apparent. If the back of the loud speaker is entirely enclosed there is generally a tendency to "tubbiness" due to cavity resonance, and if openings are introduced to relieve this, then there is usually an appreciable loss of bass. In this particular case the designers have steered a middle course and for the purpose for which the set was introduced the quality in general may be regarded as satisfactory.

There is a small aerial inside the lid, but this should not be relied upon for reception of more than the local Regional station on medium waves and Droitwich on the long waves. The short-wave band, on the other hand, is extremely lively on the self-contained aerial and we were surprised to find that Schnectady 2XAD could be received on this aerial. Those

equilibrium is reached at a harmless temperature.

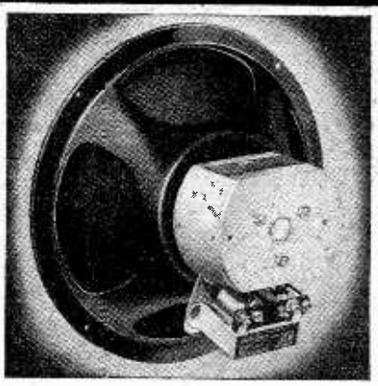
The designers deserve credit for the performance they have managed to preserve after packing so much into so small a space, and a large proportion of the cost of the set must be regarded as just reward for their ingenuity.

The Wireless Trader Year Book, 1938.—Pp. 142 + 114 diary pages. The Trader Publishing Company, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 7s. 6d. post free (overseas 9s. 6d.). Circulation restricted to the wireless and electrical trades.

BOTH technical and reference sections of this valuable annual publication have been revised and enlarged to cover the needs of wireless and electrical traders. Abridged specifications of 578 current types of receivers produced by 49 manufacturers include information on valves used, wave coverage, IF values, output, etc., and working data relating to some 800 valve types is given. There is also a list of mains voltages for nearly 1,200 districts.

Lists of manufacturers and distributors, an index of proprietary names and a list of suppliers of various apparatus and materials form a comprehensive trade directory.

NOTABLE FEATURES of the New ROLA F 742-PM



A HIGHLY SENSITIVE SPEAKER OF MODERATE SIZE AND PRICE

When high sensitivity is a prime consideration and the power the speaker is called upon to handle is insufficient to warrant the use of a Rola G.12 P.M., the Rola F.742-PM makes the ideal substitute. Its flux density is the same as the larger model—11,500 lines per square centimetre and its smaller diameter of 9¾in. makes it suitable for sets in which the G.12 P.M. could not be used. As an Extension Speaker or for Battery set use the F.742-PM is ideal whilst its price is very low for a unit of such outstanding sensitivity. A feature of some importance is the "Alnico" magnet which gives an exceptionally high efficiency-to-weight ratio.

Write to-day for Folder A.

Model F 742-PM 49/6

WITHOUT TRANSFORMER 42/-

OVER 8 MILLION IN USE

ROLA

The World's Finest Reproducers

THE BRITISH ROLA CO., LTD.
MINERVA ROAD, PARK ROYAL, N.W.10.
PHONE: WILLESDEN 4322-3-4-5-6.

Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section.

TUNING ARRANGEMENTS

RELATES to "delayed" systems of automatic volume control, in which a part of the set is deliberately "blocked" or thrown out of operation until such time as a worthwhile station is received, whereupon the "disabling" bias is removed and the circuits are restored to normal and pass the incoming programme through to the loud speaker.

It is difficult in such systems to prevent the sensitive part of the set from being thrown out of operation if a normally strong signal starts to fade, or if a slight "drift" occurs in the frequency of the local oscillator valve.

According to the invention the tuning is stabilised by means of an auxiliary control current, of, say, 20 kc/s, which is derived by beating the IF frequency with the signal frequency. This is applied to a highly selective circuit which ensures (a) that the circuit is accurately tuned before release can occur, and (b) that any casual fluctuations in the strength of the incoming signal cannot operate the noise-suppression devices.

E. K. Cole, Ltd. and G. Bradfield. Application date January 30th, 1936. No. 469670.

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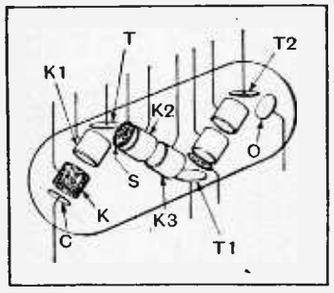
ELECTRON MULTIPLIERS

PRIMARY electrons emitted from a photo-sensitive cathode C (or an indirectly heated cathode) are first focused on to a target electrode T and then on to subsequent targets T1 and T2, the arrangement being such that the



Schematic arrangement of the elements in an electron multiplier

electrons produced by secondary emission at each target follow a path substantially clear of that taken by the incident electrons, until they finally arrive at the output or collector electrode O.

As shown in the Figure, the primary electrons emitted by the cathode C are focused by biased cylinders K, K1 on to the first target T. The resulting stream, consisting of primary and secondary electrons, then passes through an accelerating screen S and focusing cylinders K2, K3 on to the second target T1, and similarly *via* a third target T2 to the output electrode O.

The target T2 may be back-coupled through a condenser to the target T1, so as to introduce negative reaction. Or positive reaction may be applied between the targets to generate continuous oscillations.

Marconi's Wireless Telegraph Co., Ltd. Convention dates (U.S.A.) February 28th and March, 30th, 1935. No. 469488.

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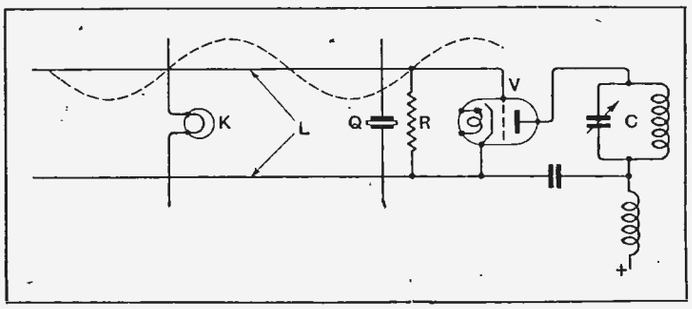
RF OSCILLATORS

IN a crystal-controlled RF oscillator, it is desirable either to limit the amount of feed-back, or else to provide some means of limiting the voltage impressed upon the crystal, as otherwise there is a tendency for the stability of the system to fall off, or for the oscillator to become blocked. Also at very high frequencies, say, of the order of 6 megacycles, excessive voltages may cause the crystal to disintegrate owing to its small dimensions.



Method of preventing excessive load on control crystal in valve oscillator.

The Figure shows one solution of the difficulty. The output circuit of the oscillator valve V consists of a tuned circuit C inserted between its anode and cathode. The grid is given a suitable bias by means of a fixed resistance R. Between the grid and the cathode is a transmission line L having uniformly distributed inductance and capacity, and being substantially a whole number of half-wavelengths long. In operation a standing-wave is set up along the transmission line as shown in dotted lines, and is held constant by a bridging resistance such as an incandescent lamp K.

A piezo-electric crystal Q is inserted in shunt across the line, at a point between a voltage node and antinode of the standing wave. By varying this point, the voltage impressed upon the crystal can be selected to be of optimum value.

The British Thomson-Houston Co., Ltd. Convention date (U.S.A.) April 16th, 1936. No. 469600.

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TELEVISION SYSTEMS

TO overcome the limitation on the size of the picture imposed by the use of a fluorescent screen, the latter is replaced by a screen consisting of a suspension of small opaque particles in a rarefied gaseous medium. When the particles of such a suspension are similarly charged, they remain opaque to incident light. But the action of the scanning stream from a cathode-ray tube causes some of the particles to become negatively charged. These are attracted towards the positively charged particles, and so render that portion of the screen transparent to an incident ray of light. The action is stated to be aided by the kinetic action of the electron stream.

Accordingly a ray of light directed upon the screen from an outside source will be modulated by the above-described action of the scanning stream of electrons, and an image of the received picture can thus be produced upon a viewing-screen located outside the cathode-ray tube where its size is not restricted by the dimensions of the tube.

M. Harman. Convention date (Austria) January 25th, 1935. No. 469558.

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CATHODE-RAY TUBES

A CATHODE-RAY tube is fitted with several different cathodes which are arranged in a row at right angles to the axis of the tube. Each is provided with a distinct control electrode and anode, and with its own pair of deflecting-plates, the arrangement being such that all three of the electron streams are made to converge at the same point on the fluorescent screen, thus increasing the normal brilliance of the picture.

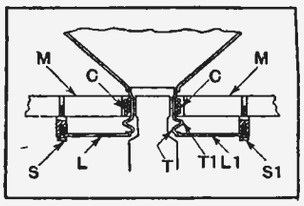
In a modified arrangement the three streams are brought to a point before they reach a common anode, so that they pass as one stream through the aperture. They are then controlled by a single pair of deflecting plates, before reaching the fluorescent screen.

E. Michaelis. Application date January 30th, 1936. No. 469127.

o o o o

LOUD SPEAKERS

ONE of the obstacles to the reproduction of notes of 7,000 cycles and over lies in the increased inertia of the moving-coil and diaphragm to frequencies of this order. Actually, so far as the diaphragm is concerned, only those parts which lie close to the moving-coil need be considered, since it can be shown that very high frequencies do not extend far out towards the periphery. Further analysis shows that most of the trouble can be traced to the manner in which the moving-coil is supported.



Moving-coil speaker designed to have a good high note response.

With the object of reducing its inertia at high frequencies the moving-coil C is supported by a tube T which is corrugated at T1 to give it added springiness or "compliance." The tube is fixed by spider arms L, L1 to studs S, S1 in the face-plate of the magnet M. This form of mounting is claimed to be substantially rigid at low frequencies, but to show high resilience at frequencies of the order of 7,000 cycles and over.

E. K. Cole, Ltd., and A. E. Falkus. Application date March 10th, 1936. No. 469197.

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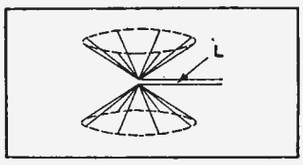
TELEVISION AERIALS

IN order to produce a radiated field which is uniform in the horizontal plan, with but little vertical radiation, the two limbs of a dipole aerial are made conical in shape. Each may consist of a continuous sheet of metal, or, as



Television aerial giving uniform radiation in a horizontal plane.

shown in the drawing, may be made up of a number of separate wires arranged in conical formation.

One end of a two-wire feed-line L is connected to each apex, these being arranged adjacent to each other. Alternatively, the two cones may be placed base to base, in which case the two feed lines are again connected to the two apices, but are parallel with an "idle" wire which serves to prevent any disturbance of the radiated field. The length of side of each cone is preferably made equal to four times the working wavelength.

Standard Telephones and Cables, Ltd. (communicated by Le Materiel Telephonique Soc. Anon). Application date December 4th, 1936. No. 469366.

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office; from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each. A selection of patents issued in U.S.A. is also included.

The Wireless World
THE PRACTICAL RADIO JOURNAL
27th Year of Publication

No. 954. THURSDAY, DECEMBER 9TH, 1937. VOL. XLI. No. 24.

Proprietors: ILIFFE & SONS LTD.

Editor:
HUGH S. POCOCK.

Editorial,
Advertising and Publishing Offices:
DORSET HOUSE, STAMFORD STREET,
LONDON, S.E.1.

Telephone: Waterloo 3333 (50 lines).
Telegrams: "Ethaworld, Sedist, London."

COVENTRY: Hertford Street.
Telegrams: "Autocar, Coventry." Telephone: 5210 Coventry.

BIRMINGHAM:
Guildhall Buildings, Navigation Street, 2.
Telegrams: "Autopress, Birmingham." Telephone: 2971 Midland (4 lines).

MANCHESTER: 260, Deansgate, 3.
Telegrams: "Iliffe, Manchester." Telephone: Blackfriars 4412 (4 lines).

GLASGOW: 26B, Renfield Street, C.2.
Telegrams: "Iliffe, Glasgow." Telephone: Central 4857.

PUBLISHED WEEKLY. ENTERED AS SECOND CLASS MATTER AT NEW YORK, N.Y.

Subscription Rates:
Home, £1 1s. 8d.; Canada, £1 1s. 8d.; other countries, £1 3s. 10d. per annum.

As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

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Editorial Comment

Christmas and Broadcasting

WE take this opportunity to extend to all our readers both at home and overseas our sincerest good wishes at this season.

As each year comes round we are impressed more and more with the extent to which broadcasting has changed both national and international outlooks, and if in some directions we deplore its misuse, we must not lose sight of the fact that these abuses are vastly outweighed by the benefits which mankind enjoys as a result of it. Broadcasting has contributed to tightening bonds of friendship, both nationally and internationally, and the Empire service in particular has forged links within the British Empire which could have been achieved by no other means.

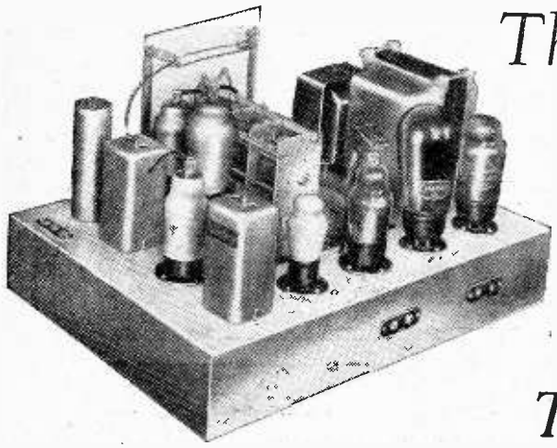
It is a matter of extreme satisfaction to us that efforts are being made to-day to improve the Empire service and to know that its importance to the Empire is appreciated; for we take some credit to ourselves for having first proposed the establishment of an Empire broadcasting service, continuing propaganda for it and urging that a start should be made in the early days, in spite of the strongest opposition from the B.B.C. and other quarters, when it was argued that it would be time enough to consider such a proposal when a reliable service to all parts of the Empire could be assured. Had such an attitude been accepted we might still have been waiting for Empire broadcasting, because even now in scarcely any part of the Empire can it be regarded as a service 100 per cent. reliable. In view of the time which it has taken for the Empire service to develop we are more than ever conscious of the deplorable position we should have been in to-day, in view of the short-wave activities of other countries, if we had waited for perfection before making a start.

Speaking of the ties which broadcasting has cemented, both in the Empire and at home, we naturally remember that Christmas is the occasion for giving and that no better token of friendship can be imagined than something which will increase facilities for receiving broadcasting or enable the programmes to be better heard. There is plenty of room for improvement in the sets used by many of our friends, whilst there could be no more welcome family gift than a new receiver to replace one which has seen its best days.

Large Variety

For those who are not prepared for the expenditure necessary for a new set there are many accessories and useful additions to choose from which will increase the enjoyment or convenience of wireless. A broadcast receiver is no longer regarded as a source of entertainment in one room alone, and extension speakers or even additional sets are increasing in popularity.

Christmas holidays are an occasion when spare time can be most usefully spent on attending to the general efficiency of the wireless set, the aerial, the earth, or the loud speaker extension leads, whilst a much neglected means of improving reception, namely the fitting of interference suppression devices, may well be the subject of a good resolution over the Christmas holidays.



The Wireless World Four-Band Su

A SUPERHETERODYNE COVERING SHORT, MEDIUM AND LONG WAVES

THE receiver described in this article has four tuning ranges—two short, one medium, and one long-wavebands. It is a superheterodyne with one RF stage, a triode-hexode frequency-changer, one IF stage with variable selectivity, a diode detector and AVC source, a triode AF stage, and a triode output valve delivering 3.5 watts to the loud speaker. The set is AC operated.

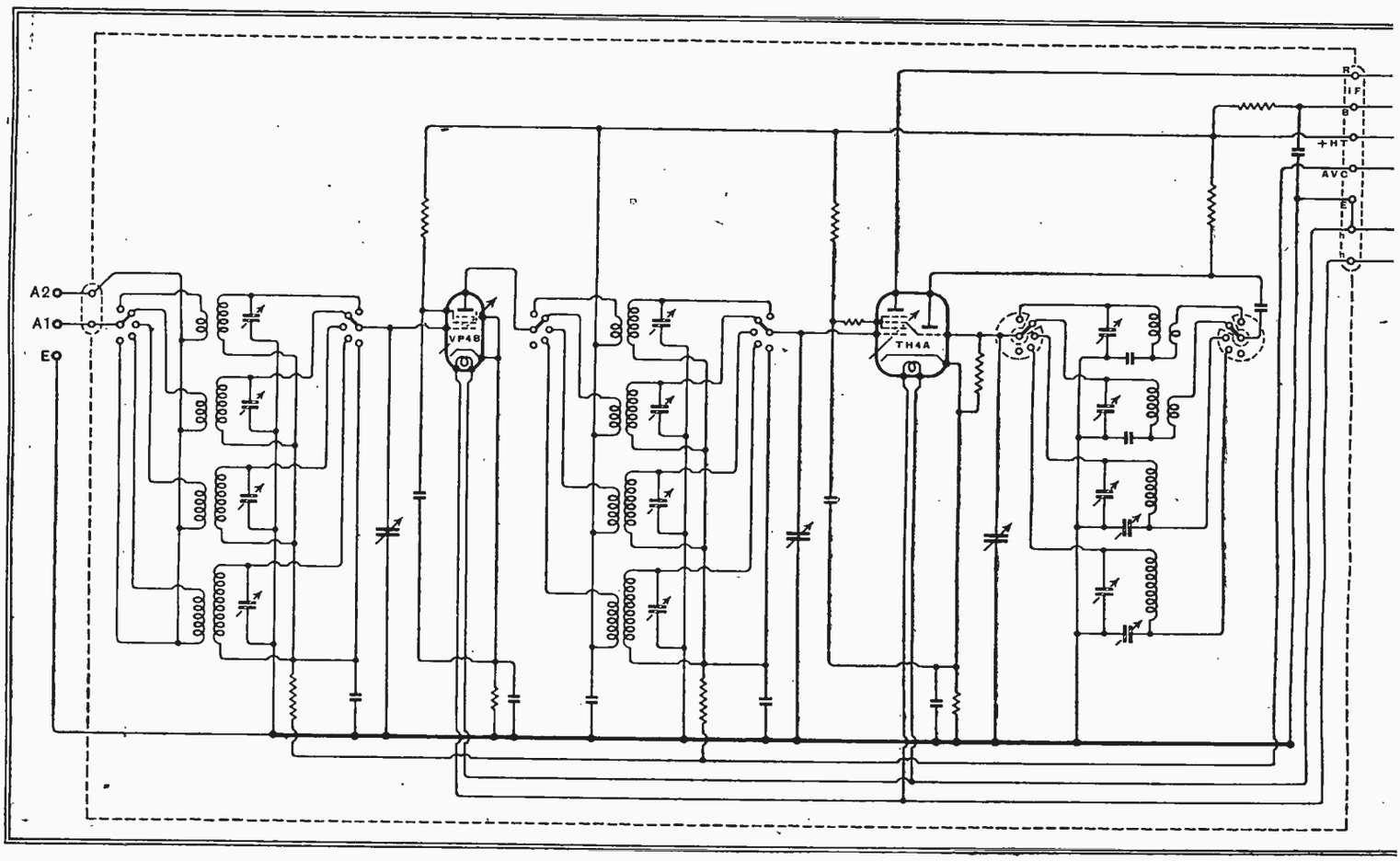
SHORT-WAVE broadcasting stations lie in bands scattered between some 13 metres and 60 metres. Altogether, only a small portion of this wide range is devoted to broadcasting, and the rest is occupied by commercial stations and the amateur bands. It is, however, necessary to cover the whole of it, for it is usually impracticable to arrange the receiver to tune only to those little bits of it which are of interest to us.

A few years ago the average short-wave set was of the straight type and comprised a reacting detector and AF amplifier; sometimes one RF stage was included. The great advantage of this type of receiver is the simplicity of initial adjustment; it admittedly calls for some skill in tuning, but when correctly designed it is a delightful set to handle. If it were not for one defect the writer would still prefer this simple straight set to any other for short-wave reception. This defect is selectivity.

The short-wave broadcast bands are now crowded and the amateur bands are congested, with the result that it is necessary to have at least as much selectivity on short waves as on the medium and long wavebands. The straight set cannot be made to give anything like adequate selectivity on short waves, and to-day it is almost useless for serious work. It will still enable distant stations to be received, of course, but usually with interference.

There is, consequently, no real alternative to the superheterodyne for short-wave work, for with this type of receiver selectivity is obtained at the intermediate frequency. This can be fairly low so that the ratio of the frequency separation of stations to the intermediate frequency is high. Moreover, we can use as many tuned circuits as we like, or as we can

Fig. 1.—The complete circuit diagram of the receiver is shown here. The parts preceding the IF amplifier are available as an assembled tuner including also the radio-gramophone switch.



afford, at the intermediate frequency, without complicating the operation of the receiver.

The lower the intermediate frequency

›er-Six

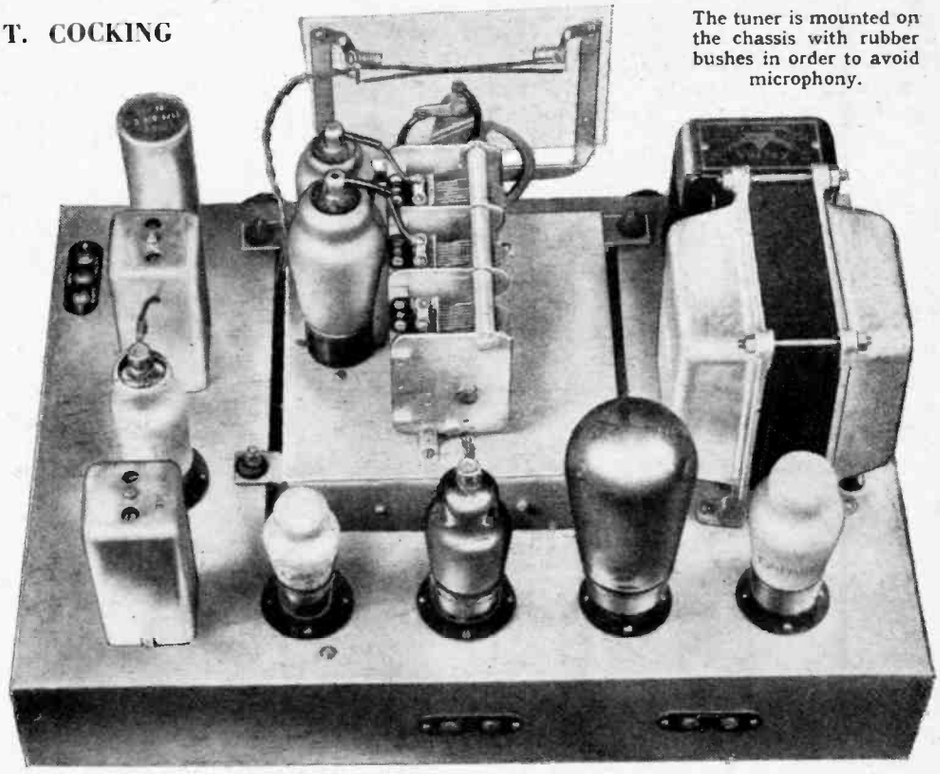
By W. T. COCKING

employed the higher is the selectivity for a given number of tuned circuits, so that it would seem wise to use as low a frequency as possible. We must not forget, however, that a superheterodyne is liable to image interference; that is, interference from a station working on a frequency higher than that of the wanted signal by twice the intermediate frequency. For the avoidance of this form of interference the signal-frequency circuits must be sufficiently selective, and for a given number of circuits the higher the intermediate frequency the less liable is a receiver to suffer from image interference.

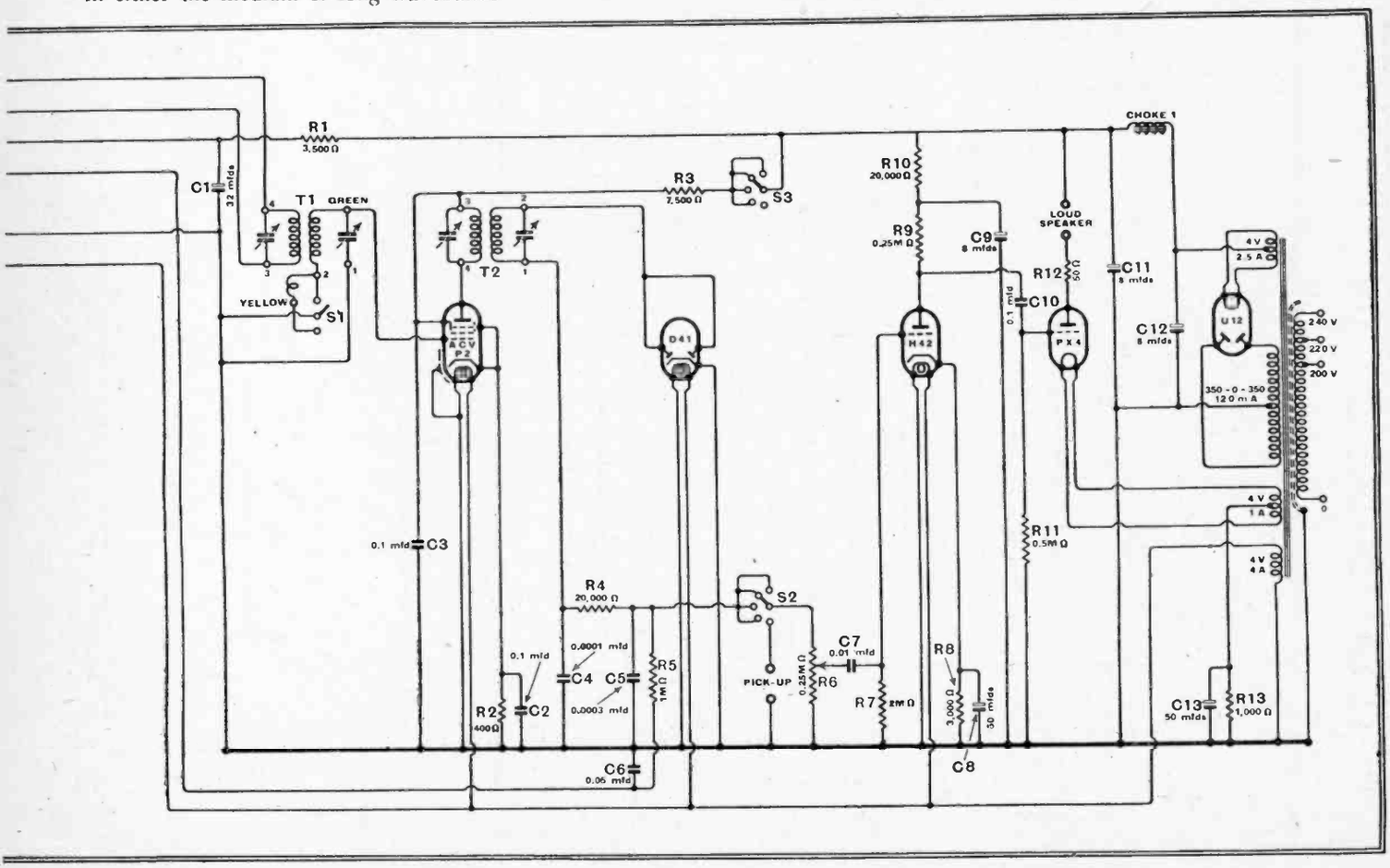
It will thus be clear that the intermediate frequency should be low, 50-100 kc/s, to obtain very high adjacent channel selectivity, but that it should be high, 2-5 Mc/s, to obtain real freedom from image interference on short waves. We cannot use a low frequency because image interference is too severe, and we cannot use a high frequency because the selectivity is not high enough. We must consequently make a compromise between the two extremes, and as the frequency cannot lie in either the medium or long wavebands if the receiver is to cover these ranges, it must lie in the gap between them.

Actually, the frequency usually adopted is 465 kc/s, but any frequency near this leads to similar results. With this frequency adequate adjacent channel selectivity is not difficult to secure, and on the medium and long wavebands image interference is easily made negligible. The position on short waves with regard to image interference is not so good, however, for the frequency separation of the signal and image, 930 kc/s, is still small compared with the operating frequency.

Since we cannot make matters better with a different practicable intermediate



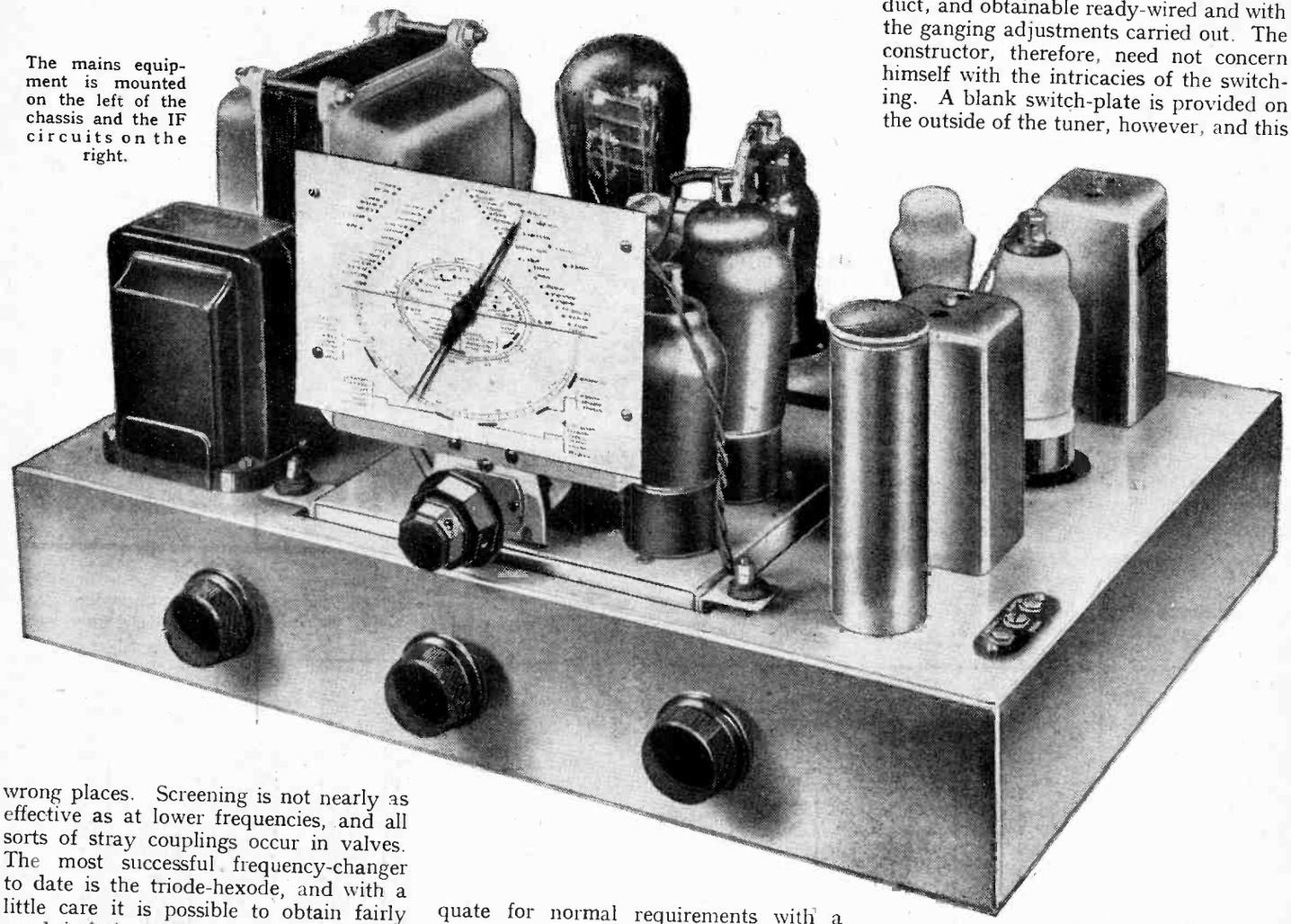
The tuner is mounted on the chassis with rubber bushes in order to avoid microphony.



Four-Band Super-Six—

frequency, we must do the best we can to provide adequate selectivity at signal frequency. Two tuned circuits are almost essential to provide any real reduction of image interference, and this involves the use of an RF stage before the frequency-changer. Such an amplifier is also desirable in order to obtain the highest signal-noise ratio.

Probably the greatest difficulties in design lie in the frequency-changer, for at high frequencies it is very difficult to keep currents where they are wanted and to prevent them from wandering into the wrong places. Screening is not nearly as effective as at lower frequencies, and all sorts of stray couplings occur in valves. The most successful frequency-changer to date is the triode-hexode, and with a little care it is possible to obtain fairly good isolation of the oscillator circuits. It is true that complete isolation cannot be obtained, and even with this valve the oscillator section sets up voltages on the other electrodes; the effects, however, can be kept to manageable dimensions, and in practice a good performance can be secured.



The mains equipment is mounted on the left of the chassis and the IF circuits on the right.

The Circuit Arrangement

Our receiver now begins to take shape, and will consist of one RF stage with two tuned circuits and a triode-hexode frequency-changer followed by the IF amplifier, detector, and AF amplifier. What we do in these later circuits depends on the sensitivity, selectivity and quality which we need. On the medium and long wavebands we want really good quality, so we shall use a triode output valve and a diode detector. It is impracticable to feed the one directly from the other, so a resistance-coupled AF stage will be interposed.

In the IF amplifier we have to choose between two low-gain stages with six tuned circuits and one high-gain stage with four circuits. The former gives higher amplification and selectivity, but costs more; there is also a limit to the amount of IF amplification which can usefully be employed, a limit set by background hiss. Experiment shows that gain and selectivity can be made adequate for normal requirements with a single stage, and we accordingly select this.

Having discussed our receiver in outline we can now proceed to details, and the complete circuit diagram is shown in Fig. 1. A single tuned circuit precedes the RF valve, and the aerial circuit is arranged so that a dipole type of aerial can be used if desired. Another single circuit, arranged as an RF transformer, is used for the coupling between this valve and the triode-hexode frequency-changer. These two circuits are tuned by two sections of the three-gang condenser, which is provided with a dual-ratio drive and a wavelength calibrated dial.

The third condenser section tunes the oscillator circuit, which is a modified Colpitt's; it is really a combination of the Colpitt's and reaction coil oscillator circuits, and it enables even oscillation to be secured over the tuning range with a reasonably low minimum circuit capacity. Separate coils are provided for each of the four ranges and each has its own parallel trimmer. In the oscillator, padding condensers are also needed to obtain accurate ganging. Multi-way rotary switches are used to select the desired range and the unused oscillator coils are short-circuited.

Variable Selectivity

The complete tuner is a commercial product, and obtainable ready-wired and with the ganging adjustments carried out. The constructor, therefore, need not concern himself with the intricacies of the switching. A blank switch-plate is provided on the outside of the tuner, however, and this can be wired up to give a change-over from radio to gramophone in the fifth position of the switch. This switch-plate carries S2 and S3, and as it is outside the tuner it is readily connected.

A single IF valve is used, and it is of the type requiring a high screen voltage. This enables a screen-feed potentiometer to be dispensed with, and a common decoupling circuit R3 and C3 to be used for screen and anode. Bias is obtained by means of R2, which is shunted by the 0.1-μF. condenser C2. The first transformer has, in addition to the normal coupling between the two main coils, an additional small coil coupled to the primary. By means of the switch S1 the earth connection to the secondary can be be made directly to the secondary or to

Four-Band Super-Six—

the secondary through the coupling coil. With the latter connections the coupling is much tighter, and a much broader resonance curve is obtained with somewhat lower amplification.

Switch S1 is thus a selectivity control. At high selectivity there is a considerable degree of sideband cutting, but really good selectivity is obtained. At low selectivity a high standard of quality can be secured.

The second transformer feeds the diode detector, which has the values for its load circuit components selected to give minimum distortion. The steady voltage developed across the load resistance R6 is used for AVC purposes, and is applied to the first two valves through the filter R5 and C6. AVC is thus non-delayed in the interests of quality of reproduction.

Following the detector comes the AF stage, for which a high-μ triode is used. It derives its input from the volume control R6, and S2 permits this to be connected to the detector on radio and to the pick-up terminals on gramophone. S3 then breaks the screen and anode circuits of the IF valve, and effectively prevents any break-through of radio signals.

The AF valve is biased by R8 and C8 and decoupled by R10 and C9. The coupling resistance R9 has a value of 0.25 MΩ, and the following grid leak R11 is 0.5 MΩ. Because of these high values, a stage gain of about 70 is secured, and an undistorted output adequate to load a PX4 output valve is obtained. The values of resistance, however, are not too high in relation to the valve and stray circuit capacities to prevent the high-frequency response from being maintained up to 10,000 c/s.

The output valve itself is a PX4 run with 300 volts anode supply, and delivering an output of some 3.5 watts into its optimum load of 4,000 ohms. It is biased by the 1,000-ohms resistance R13, which is shunted by the 50-μF. condenser C13. An anti-parasitic resistance R12 of 50 ohms is included in the anode circuit.

The mains equipment is of simple nature, and a single smoothing choke has been found adequate to ensure hum-free operation when used in conjunction with large-capacity smoothing condensers. The decoupling circuit of the AF stage, of course, provides a considerable degree of additional smoothing for this stage.

The assembly of the receiver, the wiring diagram and operating notes will be included in next week's issue.

LIST OF PARTS.

Certain components of other makes but of similar characteristics may be used as alternatives to those given in the following list.

1 All-wave tuner
Sound Sales "Sound Fourband Tuner"
1 IF transformer, 465 kc/s, **T2** **Varley BP122**
1 IF transformer, 465 kc/s, variable-selectivity **T1** **Varley BP124**
1 Mains transformer, Primary: 200-250 volts, 50 c/s. Secondaries: 350-0-350 volts, 120 mA; 4 volts, 2.5 amps.; 4 volts, 1 amp. C.T.; 4 volts, 4 amps. **Vortexion AC350**
1 Smoothing choke, 20 H, 140 mA, 250 ohms **Varley DP10**
1 Volume control, tapered, 0.25 megohm (less switch), **R6** **Centralab 72-121**
1 Switch, rotary type, SPDT, **S1** **Bulgin S92**
2 Valve holders, 4-pin (without terminals) **Clix Chassis Mounting Standard Type V1**
1 Valve holder, 5-pin (without terminals) **Clix Chassis Mounting Standard Type V1**
2 Valve holders, 7-pin (without terminals) **Clix Chassis Mounting Standard Type V2**

Condensers:
1 32 mfds., 320 volts, electrolytic, **C1** **T.C.C. 809**
1 50 mfds., 12 volts, electrolytic, **C8** **Dubilier 3016**
1 50 mfds., 50 volts, electrolytic, **C13** **Dubilier 3004**
1 8-8-8 mfds., 500 volts, electrolytic, **C9, C11, C12** **Dubilier 316**
3 0.1 mfd., 350 volts, tubular, **C2, C3, C10** **Dubilier 4603/S**
1 0.01 mfd., 350 volts, tubular, **C7** **Dubilier 4601/S**
1 0.0003 mfd., 350 volts, tubular, **C5** **Dubilier 4601/S**
1 0.0001 mfd., 350 volts, tubular, **C4** **Dubilier 4601/S**
1 0.05 mfd., 350 volts, tubular, **C6** **Dubilier 4602/S**

Resistances:
1 50 ohms, ½ watt, **R12** **Claude Lyons**
1 400 ohms, ½ watt, **R2** **Claude Lyons**
1 3,000 ohms, ½ watt, **R8** **Claude Lyons**
2 20,000 ohms, ½ watt, **R4, R10** **Claude Lyons**
1 250,000 ohms, ½ watt, **R9** **Claude Lyons**
1 500,000 ohms, ½ watt, **R11** **Claude Lyons**
1 1 megohm, ½ watt, **R5** **Claude Lyons**
1 2 megohms, ½ watt, **R7** **Claude Lyons**
1 7,500 ohms, 1 watt, **R3** **Claude Lyons**
1 3,500 ohms, 2 watts, **R1** **Claude Lyons**
1 1,000 ohms, 3 watts, **R13** **Claude Lyons**

1 Group resistance board, 5-way **Bulgin C31**
1 Skeleton captive screw strip, 3-way, A1, A2, E **Bulgin T11**
1 Skeleton captive screw strip, 2-way, pick-up **Bulgin T10**
1 Skeleton captive screw strip, 2-way, speaker **Bulgin T10**
3 Knobs (walnut) **Bulgin K24**
2 Plug-top valve connectors **Belling-Lee 1175**
2 Lengths screened sleeving **Goltone**
Chassis **B.T.S.**
Miscellaneous: **Peto-Scott**
4 lengths systoflex; 2 ozs. No. 20 tinned copper wire, etc. Screws: 30 ¼in. 6 BA R/hd.; 8 ¾in. 4 BA R/hd.; 4 1in. 4 BA R/hd.; all with nuts and washers.

Valves:
1 D41 (Met.), 1 H42, 1 PX4, 1 U12 **Osram**
1 AC/VP2 (Met.) **Mazda**
1 VP4B (Met.), 1 TH4A (Met.) **Mullard**

Royal Naval Wireless Auxiliary Reserve

THE following information has been sent to *The Wireless World* by the Admiral Commanding Reserves:—

There are a few vacancies in the R.N.W.A.R. in London, Cambridge, Bristol, Manchester, Scarborough, Brighton and Newcastle.

The object of this organisation is to provide a reserve of wireless operators, trained in naval procedure, for naval service at home or abroad, ashore or afloat, in time of war.

It has a particular appeal to men holding P.M.G. certificates and other radio enthusiasts who are interested in the transmission of messages by W/T and men from almost every walk in life have joined.

Members must be the sons of British-born parents and be between the ages of 18 and 55. They must have no ties which will prevent them joining the Navy in the event of war.

Applicants need not have any special wireless qualifications, but they should have a knowledge of the Morse code and either be in possession of or be able to construct a high-frequency receiver.

The country is divided into districts and units. Training centres where oral instruction is carried out under the direction of either a qualified member or a naval rating have been instituted in all towns where there are units. Organised W/T training is also carried out throughout the country. Two hundred members have reached a high degree of proficiency in naval procedure, and over 150 others have a good general knowledge.

Members who have reached a certain standard are allowed to volunteer for 14 days' naval training annually.

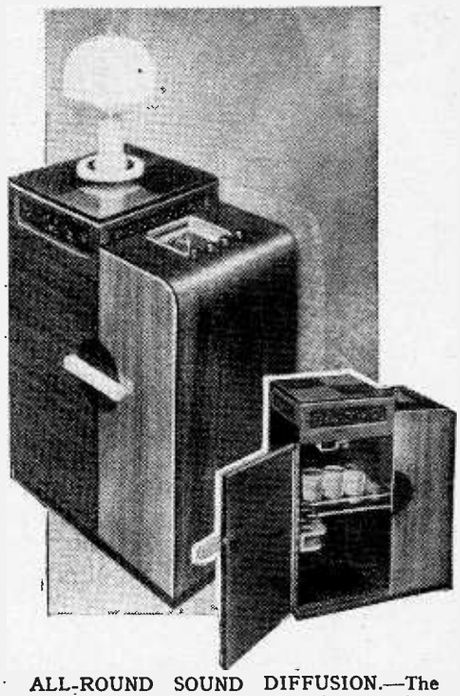
Members do not receive pay in peace time except when undergoing naval training, but several concessions are granted to them.

Those interested are requested to apply by post for further particulars to: The Admiral Commanding Reserves, Admiralty, Queen Anne's Chambers, Tothill Street, London, S.W.1, and interviews will then be arranged with an official of the Reserve to assist the applicants in their decisions.

Photograms of the Year, 1938. Edited by F. J. Mortimer, Hon.F.R.P.S. Pp. 32, 64 plates. Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 5s., or cloth bound 7s. 6d.

This publication, which has been issued for over 40 years, includes reproductions and articles by photographic experts hailing from all parts of the world, and is invariably recognised as the authoritative annual publication recording the progress of pictorial photography.

Sound Distribution



ALL-ROUND SOUND DIFFUSION.—The loud speaker of this new American receiver is mounted horizontally below a deflecting cone which, it is stated, distributes the sound equally and evenly in all directions through the apertures cut in all four sides of the cabinet. As shown in the smaller inset photograph the space below the speaker is available for storage purposes.

B.B.C. Research

ORGANISATION AND WORK OF THE DEPARTMENT RESPONSIBLE FOR TECHNICAL DEVELOPMENT.

By H. L. KIRKE

The B.B.C. Research Department is housed in a building that was once a convent.

THE activities of the Research Department of the B.B.C. must be of considerable interest to many readers of *The Wireless World*, and for this reason I have been asked to write a general description of the work and to give some idea of the problems which arise and how they are dealt with.

The Research Department started in the early days of the B.B.C. in a very small way. When I first joined the B.B.C., the entire staff—about four of us in all—of the Development Department, as it was called, was housed in one small room.

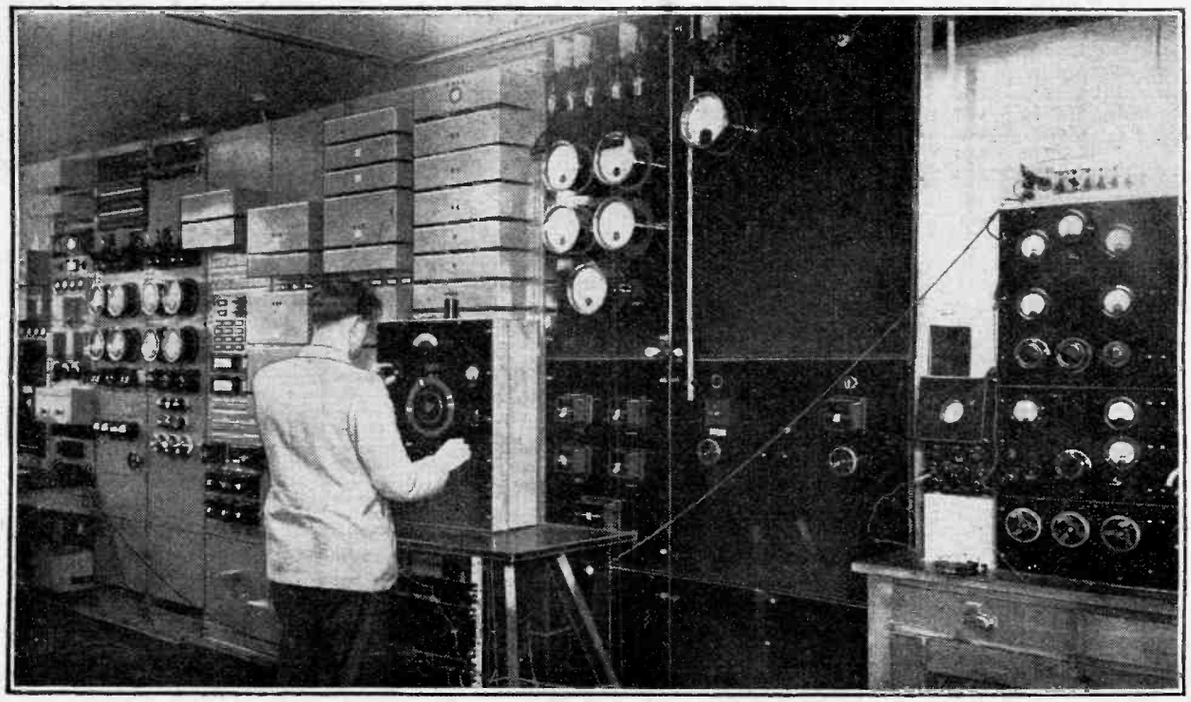
Our first experiments were done either in the control room, studio or transmitter room, usually to the annoyance of the engineers on duty there, and, needless to say, there was much burning of midnight oil.

A few months later we were given temporarily a room to experiment in, but this was soon taken away in order to provide space for a larger control room, and we had at least four moves in Savoy Hill and its extension before we were turned out into the cold world and made to look for new premises outside. These we eventually found at Clapham Park, which are now the headquarters of the Equipment Department. Yet another move had to be made owing to expansion, and now we have a headquarters which was once a convent, but which has made a very satisfactory research building, although even now we are finding space rather cramped.

In the early days there was practically no specialisation. Any engineer was put on to almost any job that turned up. Nowadays, however, with a larger staff, and much more complicated and exacting work, it is necessary to specialise, and the work of the Department has been divided into groups roughly as follows: Radio, studio acoustics (including microphones and loud speakers), audio-frequency circuits, measuring apparatus and recording, valves and television.

As its name implies, the Radio Section is responsible for all purely radio work. This includes anything from very low to very high power and all forms of receivers and transmitters. On the transmitting side are aerials, field-strength measuring, testing of sites for new stations; measurement of field-strength of new stations and the checking of the field from time to time of existing stations; research work on modulation systems with the object of improving quality and increasing efficiency, and also on power amplifiers with the same object; methods of synchronising transmitters on the same wavelength; work on short and ultra-short waves, which includes the design of aerials for the Empire Station; co-operation with manufacturers in the design of transmitters; the development of field-strength measuring apparatus for medium, short and ultra-short waves; and, of course, all the laboratory apparatus such as bridges, etc., required in connection with research work.

On the receiver side we keep abreast of the times, and a number of commercial receivers of all types are tested from time to time. The section does a good deal of work in the design of high-quality receivers for our own purposes and in specifying the performance of such receivers as are put out to tender. They are, of course, responsible for such work as the design of the diversity receiving apparatus for short waves, as used at the Tatsfield Receiving Station, and for general co-operation with Tatsfield on receiver problems of a varied nature arising from wavelength checking, relaying, modulation recording and similar work.



In the RF laboratory of the B.B.C. Research station. A harmonic analyser is in use, while a complete set of frequency - multiplying equipment is seen in the background.

The design of aerials is one of the most interesting subjects. For this work a great deal of calculation is required. One of the difficulties is

B.B.C. Research—

that it is not possible to erect experimental aerials in view of the high cost, and, in general, the checking up of our calculations has to be done on actual aerials which are designed for particular stations, although in some cases research work is done on small-scale models in which the wavelength is, of course, reduced in proportion. For example, a model aerial to represent a 500ft. mast radiator working on, say, 300 metres, could consist of a 50ft. aerial working at 30 metres, or a 100ft. aerial at 60 metres, all dimensions being reduced on the same scale. Naturally, there are difficulties and pitfalls in model work at such high frequencies, but the art of measurement at these frequencies has progressed so much that it is quite possible to carry out fairly accurate work.

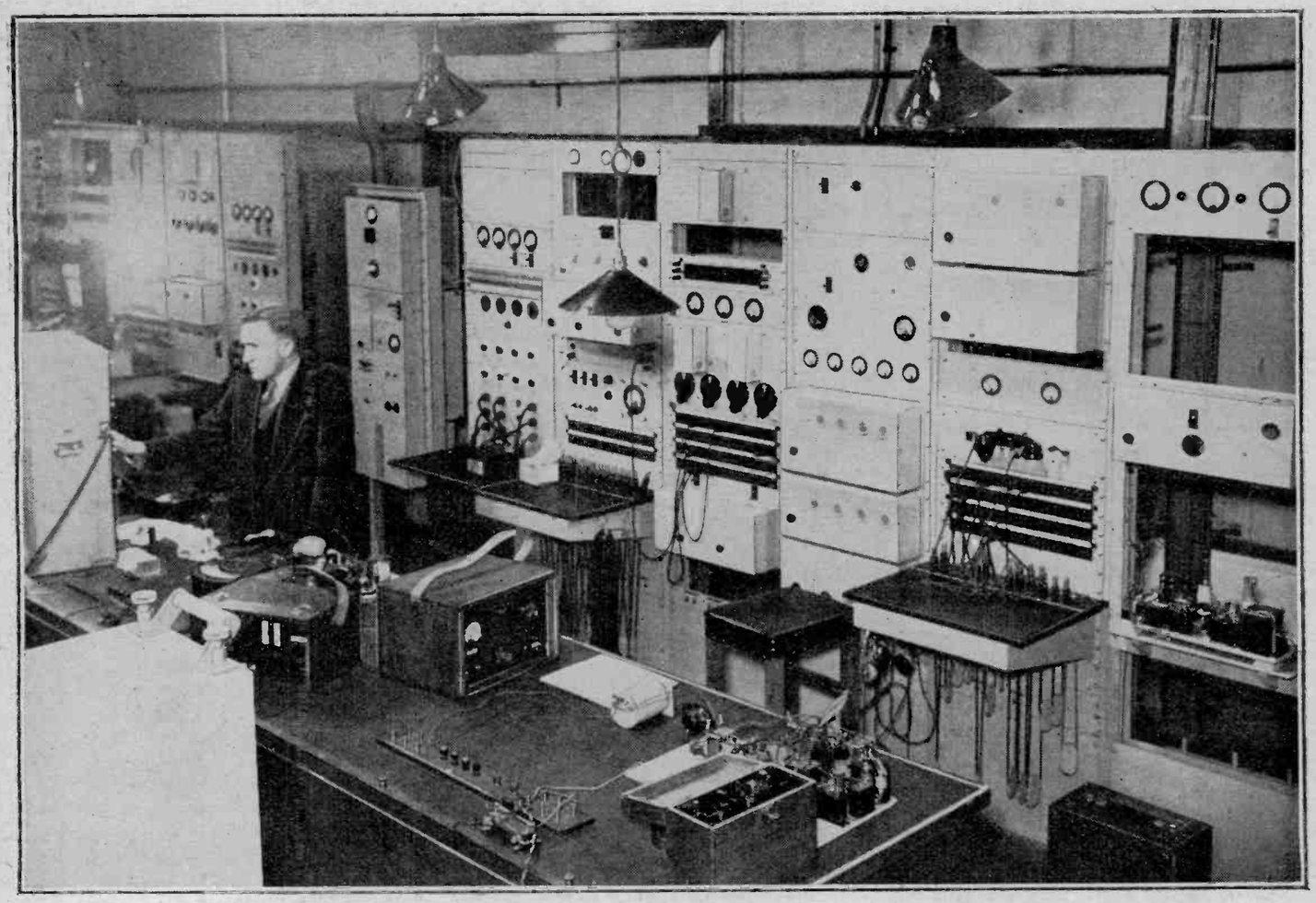
The type of aerial which has been used for some years in the B.B.C. consists of a number of wires suspended from the top of a 500ft. mast, in the form of an umbrella, but recently it has been found that this form of aerial is not so efficient as a mast radiator, or even a good "T" aerial supported between two masts. All our modern stations, with the exception of Droitwich, where the long wavelength and questions of band-width make a mast radiator impossible, are being equipped with mast-type radiators. The Lisnagarvey Station uses a cantilever-type mast, with an adjustable topmast and a top capacity. This mast has given good results, both as regards efficiency and anti-fading properties. Next on the list is Stagshaw, which has just been completed. Testing of both the transmitter and the aerial has been in progress for the last two months.

The design of the aerial system for Start Point has just been completed. This station, because of its position in relation to the area it has to serve, is being equipped with a form of directional aerial which will prevent energy from being wasted over the sea, and which will give the maximum field-strength where required. Advantage is being taken of the oversea path to the coastal districts which this station is to serve, and for this reason greater range than usual will be obtained, and in consequence special care will have to be taken in arranging the anti-fading properties of the aerial system.

Research work on Empire Station aerials has been going on for some years. This work is of necessity somewhat protracted, as the conditions of transmission via the Heaviside layer are far from uniform, and the efficiency of an aerial can only be determined in terms of comparison with other aerials by field-strength measurements at a distance and by reports from selected listeners. Field-strength measurements on the ground are of little value in short-wave work, while aeroplane measurements are very useful but expensive.

Many types of aerial using both horizontal and vertical radiators were tried at Daventry, and many experiments were carried out to determine the optimum height required for these aerials before a more or less standardised arrangement could be adopted. Then came the necessity for designing the feeder system connecting the transmitters to the aerials. This is a very complicated business for a station like Daventry, which has 24 arrays, all of which must be capable of being switched to one of the four transmitters. Switching feeders carrying such high frequencies is by no means a simple business, and much work had to be done not only on the type of feeder used but on methods of switching, before a reliable and convenient system was developed.

One of the difficulties in short waves is that very small irregularities cause considerable standing waves on the feeders. While this would not be a serious matter at low power, at high powers of the order of 50 kilowatts or more very high voltages may be set up by standing waves which would cause brushing or flash-over. If standing waves are present to any degree, the impedance of a feeder line will



Typical rack-mounted apparatus in the AF laboratory. The apparatus on the bench includes a portable peak volume meter and an experimental OB amplifier.

B.B.C. Research—

depend upon the exact position at which it is terminated—that is to say, its electrical length; and, as feeders must be capable of being switched to various transmitters, it is very important that the impedance of all feeders at the switching point should be the same.

It was decided, having regard mainly to the cost, that open wire feeders were the best proposition for the Empire Station. With open-wire feeders the capacity of the insulators along the line, together with that of the corona rings on the insulators (the latter are necessary to prevent brushing at high power) makes the standing-wave problem very acute, and a considerable amount of arduous experimental work in the open, in all sorts of weather conditions, was necessary before the problem was solved.

Short-wave Bridges

It was then necessary to carry the solution into practical operation by lining-up and adjusting all the aerials and feeders. This was done by engineers of the Research Department, assisted by the station staff at Daventry. The work was made much easier and was considerably hastened by the use of a radio-frequency impedance bridge which had been designed in our laboratories especially for this work. Some years ago impedance bridges for even medium frequencies were looked upon as very much the laboratory type of instrument; but now the bridge technique is so far advanced that short-wave bridges are used for almost all such work

In the design of transmitters the two main considerations are economy and high quality. High quality can always be achieved at the expense of economy, and vice versa. With the use of higher power the need for high efficiency is an important one, as the power bill of a high-power transmitter is very considerable. In the older type of transmitters in use by the B.B.C. the efficiency of the final amplifying stage is about 30 per cent., and when all the auxiliaries are taken into account the power required from the mains for a 100 kW. transmitter is in the neighbourhood of 500 kilowatts—an overall efficiency of 20 per cent. In more modern types the overall efficiency has been increased to between 25 per cent. and 30 per cent. by the use of "Class B," or "floating carrier" systems of modulation.

There are, however, several other methods of improving the efficiency of transmitters, at the same time retaining the very desirable high quality. An important part of the work of the Radio Section is the investigation of proposals of this sort, both by theoretical study and by low-power practical experiments.

Synchronising transmitters on the same wavelength is an interesting problem which has always presented considerable difficulties which seem to increase with each new station synchronised. In the early days it was thought that tuning forks operating at a low frequency, the frequency being multiplied to drive the station, would form a sufficiently accurate drive to operate transmitters on the same wavelength if each station was driven independently by its own fork. It was found, however, that, although tuning forks had worked as frequency standards in laboratories with a fairly high degree of stability, it was not possible to maintain this stability under practical workaday conditions in our stations. Our tests have shown that, in order that the listener may not be inconvenienced by the effects of synchronising, it is necessary that the frequency difference between any stations in a synchronised group should not be more than one part in ten millions; that is to say, the beats between any transmitters should not be greater than one in ten seconds. Such periodic variations in field-strength would not normally be distinguishable from those caused by ordinary fading. In order to obtain such accuracy it is necessary to employ linking by means of telephone lines. In this method a fork at one station sends a tone by a line to other stations in the group, where the received tone is multiplied by a frequency multiplier in the same way as at the original station. This line scheme introduced considerable difficulties, as it was found that the very small variations in the amplitude or phase of the received tone resulted in considerable variations in the phase of the finally generated high-frequency carrier, and since when two carriers of the same frequency are combined a phase change in one of them results in an amplitude change in the resultant combination, it will be seen that phase changes are very important. To reduce these phase changes to a negligible value it has been necessary to make use of both electrical and mechanical filters, the latter being a tuning fork itself.

Redesigned Frequency Multipliers

This synchronising work is an example of the research and development carried out by the Radio Section, who, having produced a "first model" which has been proved to be satisfactory, hand over the work to another department who are responsible for equipping the transmitters concerned. When it was decided to synchronise Burghead with Scottish Regional, Penmon with Welsh Regional, and Scottish National with the London and North National transmitters, it was decided to redesign the frequency multiplier and other equipment used for this work, since experience had shown that considerable modifications were necessary to obtain satisfactory performance. The Radio Section was responsible for all the experimental and preliminary design work. When this was completed, the electrical circuits were specified, and the general layout of the required design was indicated.

Work is now in progress on the development of a much improved type of crystal drive. The experience gained on this work may lead to the more extensive use of crystals at synchronised stations, and this may, in turn, reduce the amount of frequency checking by line link between these stations, since the frequency stability of present-day crystals is extremely high. Although the development work is being done in the research laboratories there is considerable co-operation with outside firms and organisations on the question of the crystals themselves and the constant-temperature ovens required for them.

(To be concluded.)

Television Programmes

Vision 45 Mc/s. Sound 41.5 Mc/s.

THURSDAY, DECEMBER 9th.

3, Adrina Otero in Spanish dances. **3.10,** Kuda Bux, the man with the X-ray eyes. **3.20,** British Movietonews. **3.30,** The White Coons.

9, Ballroom dancing demonstration. **9.10,** Clothes-line, No. 6—Grandmamma looks back. **9.20,** Gaumont-British News. **9.30,** The White Coons.

FRIDAY, DECEMBER 10th.

3, Reine Paulet in Continental songs. **3.5,** Marcel Boulestin shows how to make Sauce Sabayon. **3.20,** Gaumont-British News. **3.30,** The Irish Players in Lady Gregory's "The Rising of the Moon."

9-10.30, "Once in a Lifetime": a play by Moss Hart and George Kaufman that burlesques Hollywood's film methods.

SATURDAY, DECEMBER 11th.

3, "Numskull Jack," a Hans Andersen story. **3.10,** Cartoon Film. **3.15,** The Hogarth marionette menagerie. **3.30,** British Movietonews. **3.40,** Dancing Time.

9, Kuda Bux. **9.10,** Adrina Otero in Spanish dances. **9.20,** Gaumont-British News. **9.30,** The Matania Operatic Society in Act III of Verdi's "Aida."

MONDAY, DECEMBER 13th.

3, Ronald Frankau. **3.10,** British Movietonews. **3.20,** Vic-Wells Ballet Company in Act II of Tchaikowsky's "Le Lac des Cygnes."

9, Reine Paulet in Continental songs. **9.10,** Gaumont-British News. **9.20,** Act II of "Le Lac de Cygnes."

TUESDAY, DECEMBER 14th.

3, Fashion Forecast. **3.15,** Gaumont-British News. **3.25,** Theatre Parade.

9, Fashion Forecast. **9.10,** Cartoon Film. **9.15,** Body Line, No. 6—demonstration by students training to be Keep-Fit leaders, watched by Earl Stanhope. **9.30,** British Movietonews. **9.40,** "Tele-Ho": a television revue written for Nelson Keys by his son, John Paddy Carstairs.

WEDNESDAY, DECEMBER 15th.

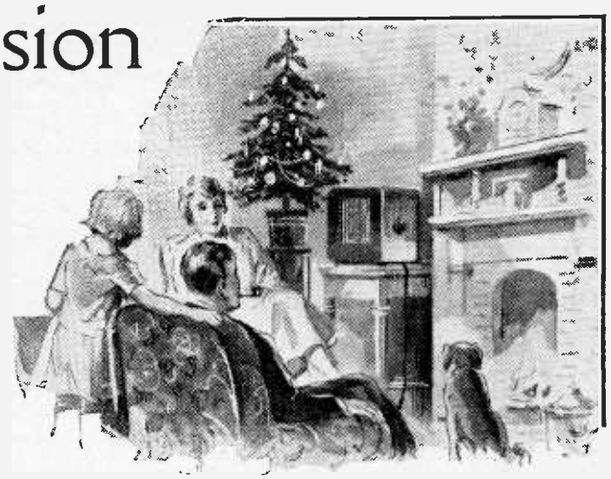
3, Cabaret. **3.20,** British Movietonews. **3.30,** 103rd edition of Picture Page.

9, Cabaret. **9.20,** Gaumont-British News. **9.30,** 104th edition of Picture Page.

Soldering: The Highbrow Aspect

THOSE who are concerned with the technique of soldering will find much to interest them in a pamphlet recently issued by the International Tin Research and Development Council, Manfield House, 378, Strand, London, W.C.2. Under the title of "The Wetting of Metals by Metals, with Particular Reference to Tinning and Soldering," the pamphlet contains a review of present knowledge of the chemical phenomenon of "wetting" and the action of fluxes in lowering the surface tension of molten metal so that it can spread more rapidly. Copies of the pamphlet are obtainable, free of charge, from the Council.

Adding an Extension Loud Speaker

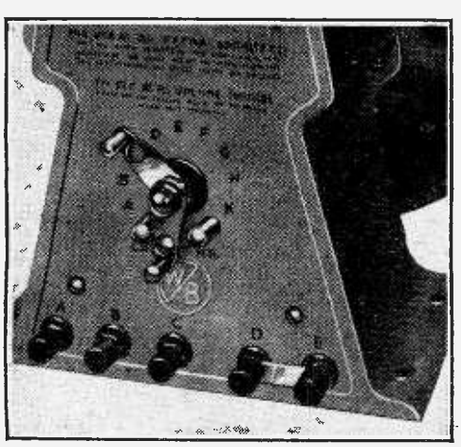


Simple Precautions When Purchasing and Installing

FOR some unaccountable reason the decision to acquire an extension loud speaker seems always to be accompanied by an element of urgency. Throughout the summer months we find it no great hardship to go out of our way, if necessary, to the room where the main receiver is installed in order to hear some special item. Then along comes the first cold spell of winter, or eleventh-hour arrangements are made for a party, and firm instructions are issued that we must not return home that evening without the means of providing broadcast reception in at least two rooms of the house.

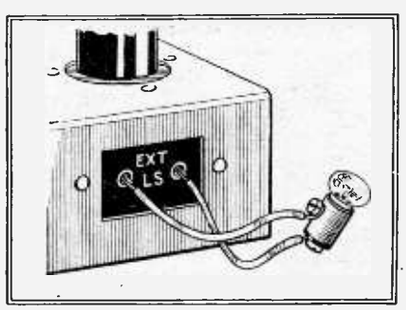
Unfortunately, the extension loud speaker is by no means a standardised article of commerce. The majority of receivers nowadays are arranged for what is termed a "low-impedance" output to the extension loud speaker, but the remainder—and these include many well-known names—are of the "high-impedance" type. While a good deal of latitude is permissible in matching the loud speaker impedance to that of the set, the gap between the high- and low-impedance class of loud speaker is so wide that if the wrong type is chosen only the feeblest sounds will emerge.

If time is short and the output impedance of the set is unknown, the best plan is to play for safety and invest in a loud speaker incorporating a "universal" matching transformer. All one need do then is to connect it to the set and try all the alternative connections until the best volume and quality of reproduction are obtained. In certain well-known makes the process of finding the correct ratio is simplified by rotary or sliding switches, and it takes no longer to find the best setting than it does to tune in a station on the receiver. Incidentally, the extension loud speaker with a universal transformer is a much more saleable article—a point worth considering if there is a possibility that one might like to change to another type at some future date.



Variable ratio switching and terminal arrangement provided on a speaker to accommodate practically any type of output.

The cost of an extension loud speaker can, however, be appreciably reduced if one can give the dealer some guide regarding the impedance required. A transformer will still be necessary for a high impedance output, but a single-ratio transformer (and the dealer should be able to decide on the ratio if you can tell him the type of output valve in the set) will be appreciably less in cost than one designed to meet every contingency. With a low impedance output, on the other hand, no transformer is required and anything up to 15s. or a £1 may be saved in the cost.



High or low impedance? A simple test with a flashlamp bulb; the lighting of the filament indicates provision for a low-impedance speaker.

Reference to the book of instructions supplied with the set will in most cases provide the necessary information regarding impedance, but if this has been lost or mislaid there is a simple test which at the most will cost no more than 1d., and with any luck need not involve expenditure of even this amount of money.

High or Low?

A standard flashlamp bulb requires about 1 watt of energy to light it fully. This is comfortably within the powers of even the smallest table model receivers, and by a piece of good fortune the resistance of the lamp is of the same order as the output impedance of sets with a low impedance output. If the lamp is connected to the extension loud speaker sockets it will light up and flicker at a normal volume level if the output is of the low-impedance type. On the other hand, if a high-impedance output has been provided there will be no sign of any activity in the lamp even with the volume control at maximum. Reasonable care is necessary in making this test otherwise the lamp may be instantly burnt out, and if the momentary flash passed unobserved one might be led into diagnosing a high-impedance output from a burnt-out lamp. Also it is possible in some sets to get a shock from one of the terminals of the extension loud speaker if the output is of the high-impedance type, so the procedure should be as follows:—(1) Tune in the local station. (2) Turn volume control to minimum. (3) Switch off set. (4) Insert test lamp leads. (5) Switch on set and increase volume gradually, keeping the lamp under constant observation.

Illuminating Illuminations

This test, besides providing the answer to the question of the moment, is most instructive concerning the energy associated with different sounds. Those in the lower part of the musical scale, such as the drums and double bass, produce much more illumination than the high-pitched violins, and in a noisy set it is rather a shock to find that crackles and atmospherics provide far more illumination than the broadcast programme!

Having ascertained the type of output, one can now go ahead and order the auxiliary loud speaker, and if the matching is not exact there will be no great loss of either volume or quality.

Next we come to the question of wiring. Theoretically, long leads are bad whether the extension loud speaker is of the high- or low-impedance type, but as the whole point of an extension loud speaker is that it shall be worked at a distance, the length of leads must be accepted. Looking at the matter again from the theoretical standpoint, it would be ideal to have parallel wires well separated and crossing over at frequent intervals, but again in practice lighting flex will most probably be used, and there is this to be said for it that it is already laid up non-inductively so that there need be no fear of pick-up from stray magnetic fields. Whichever type of impedance is used, however, flex of good

Adding an Extension Loud Speaker—

quality must be employed. In the case of the low-impedance loud speaker the gauge of wire in the conductor should be above the average, but for a high-impedance unit the size of wire is immaterial and good insulation is of the first importance for the reason already mentioned, that one lead may be at the positive HT potential of the set.

With regard to the placing of the extension loud speaker a good deal of latitude is permissible. If the back of the cabinet is open or freely ventilated it is not wise to put the loud speaker too near to the wall, but in the majority of cases the unit is fairly well enclosed and the quality of reproduction will be more or less independent of its position in the room. There is, however, the question of focusing of high notes in a beam at right angles to the front of the cabinet which is a peculiarity of all loud speakers with circular cone diaphragms. Often the loud speaker is hung fairly high from a picture rail, in which case it is advisable to arrange for a slight downward tilt in order to preserve the balance of high notes at the point where the listener will normally sit. Such precautions are not so necessary where an elliptical diaphragm is used, as the high note distribution is in this case through a wider angle.

The control of volume is a matter for the individual taste of the listener. Most people will find an average volume level which will hold for all types of broadcasting, but those who prefer to cut down the volume of speech relative to that of music will call for a volume control incorporated in the extension loud speaker to avoid the necessity of making a journey to the receiver. The crudest volume control takes the form of a resistance in series with the extension unit, but this will result in a severe curtailment of high frequency response at low volume levels. A simple potentiometer is perhaps a little better from this point of view, but also results in top cut. Undoubtedly the best arrangement is that known as a constant-impedance volume control, which is generally a potentiometer in which both the series and parallel portions are altered simultaneously to present a constant-impedance to the output terminals of the set. In this arrangement reduction at high frequencies, although still present, is generally much less than in the aforegoing types, and the majority of makers who fit volume controls to their loud speakers have found this to be a satisfactory arrangement.

In conclusion, mention should be made of the "Long Arm" remote control device incorporated in many WB loud speakers. This is a logical complement to remote volume control, for it enables the receiver to be switched in from the same point.

Training Wireless Engineers

THE NEW CHELMSFORD COLLEGE

EVER since the earliest days of wireless communication, the Marconi Company has had a scheme for training budding engineers entering its service. A little later the scope of the instructional section was widened to give specialised training to members of the staffs of various organisations that had installed Marconi apparatus. Now, thanks to extensions that have recently been made to the buildings housing the Marconi School of Wireless Communication, a larger number than hitherto of private students—those who do not necessarily intend to enter the company's service—are being accepted.

The new buildings, which include a students' hostel adjoining the school, are extraordinarily well adapted for their purpose and are situated on the outskirts of Chelmsford, at some little distance from the company's main works. The extensive grounds of the school afford ample space for the erection of a variety of aerial arrays.

Intending students are required to have a good groundwork of fundamental knowledge in physics and engineering, but not necessarily in radio. Most entrants come with a degree; the school is, in fact, primarily a link between the universities and practical work, but it is a flexible organisation and no hard-and-fast qualifications for entry are laid down. In cases where it seems likely that a would-be student has insufficient fundamental knowledge to benefit from the instruction given, the Principal, Mr. H. M. Dowsett, generally advises on a course of preliminary studies elsewhere. Although mathematics and "paper work" generally are by no means neglected, instruction is essentially based on experiment and practice. For example, when a member of *The Wireless World* staff recently visited the School, investigations were being carried out by students, individually or in groups, on such diverse subjects as detection characteristics of a diode, effect of grid-leak resistance changes in an AF amplifier, broadcast receiver frequency characteristics, and selectivity measurements of a tuned circuit with the help of a CR oscilloscope directly calibrated in decibels. As a preliminary to more advanced transmitter studies, the behaviour of a small oscillator using a low-power receiver valve was being analysed. Another group of students was engaged, again with cathode-ray gear, in studying speech inversion equipment, which is used for rendering conversations on a radio-telephone link unintelligible to unauthorised listeners.

The School is extremely well provided with apparatus—there must be many thousand pounds' worth—and much of it is of the latest type; for instance, a short-wave direction-finder has recently been installed.

Transmitting gear, which includes long-, medium- and short-wave equipment, is housed in a large hut in the grounds, while a smaller building contains a model broadcast studio and a 2 kW transmitter.

The general course in wireless communication embraces the whole field of wireless principles as applied to the art of communication, and covers a period of five months. There are other courses in advanced wireless communication and in specialised subjects such as direction finding, marine communication, television, broadcast receiver and transmitter design and telephone terminal equipment.

In the transmitter hut at the Marconi School. A small short-wave set is seen in the foreground; one of the students is making adjustments to the large power unit which supplies current to the various transmitters.

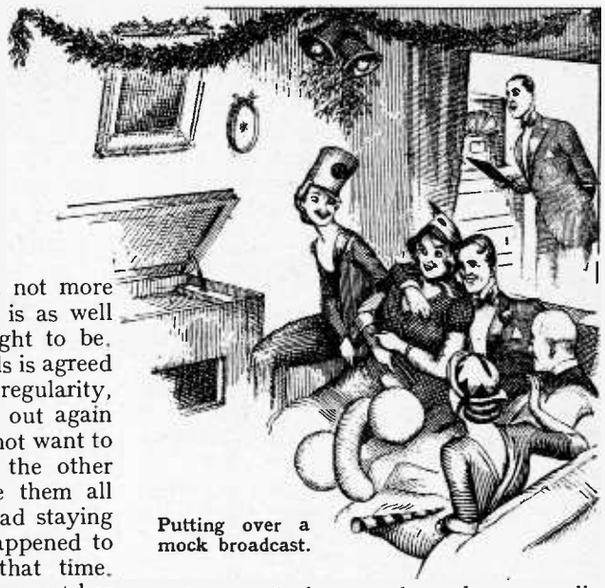
A Wireless Annual

NOW in its 15th year of publication, *The Chronicle Wireless Annual* for 1938 has recently been issued. As usual, this useful book contains information on a diversity of subjects and has something for every kind of wireless enthusiast. For the constructor, for instance, there are several "how to build" articles, including a description of a short-wave set. For the general readers there are articles on radio interference and its suppression, and on getting the best results from a receiver. The present position of the short waves and television is reviewed in separate sections, while the reference pages contain lists of stations, etc.

The Annual costs 1s. and is issued by the publishers of the *Manchester Evening Chronicle*.

What To Do About Christmas

By "CATHODE RAY"



Putting over a mock broadcast.

NOW is the time of year when one has persistent dreams of waking up and finding a big-screen projection television receiver in one's stocking. But like other and less pleasant dreams the arrival of what passes at this season for daylight causes it to fade even more suddenly and completely than the Dellinger Effect (in case you don't know what that is, I am discussing it in a week or two).

By the chill murk of an actual December daybreak, therefore, it is necessary to apply one's thoughts to the problem of providing some justification for referring to the season as festive.

Last year at this time I called attention to a number of accessories that might be favourably considered by those persons who, like myself, are not financially adjusted for the annual purchase of complete receivers of the more refined types.

The usual bright suggestions about "Make it a Radio Christmas this year!" generally include pictures of the latest in gang condensers and sets of variable-selectivity IF transformers. But I cannot imagine myself on the fateful Noel morn presenting articles of this sort to any of my relatives. On the other hand, extension loud speakers are welcome almost everywhere, and are now obtainable at quite practicable prices. There are still lots of people who have to go and shiver in some cold room if they want to listen to a broadcast. No wonder their numbed hands reach for a pen to write a complaint about the dreariness of the programme! I want to reiterate my recommendation too, of remote control. Bed is a most satisfactory place for listening in comfort, but it loses much of its appeal if one has to get out and go downstairs to switch the receiver off just at the psychological moment for turning over and going to sleep. My impression is that not more than one house in a thousand is as well fitted with extensions as it ought to be.

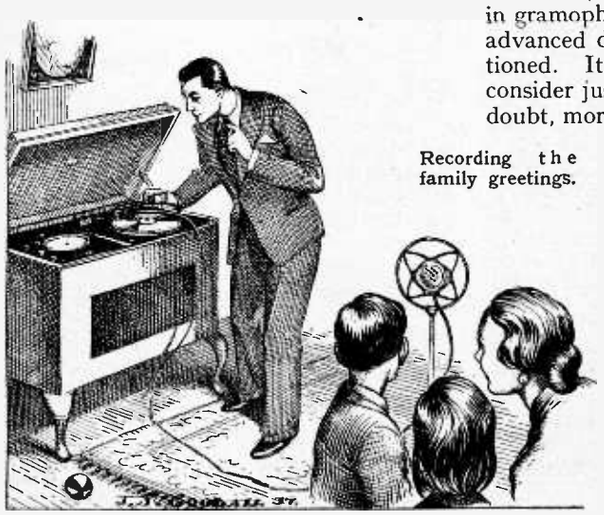
The futility of Christmas cards is agreed by all every year with great regularity, and as regularly they are sent out again the following year. One does not want to overlook friends entirely; on the other hand one can't afford to give them all good presents. Recently we had staying with us a Dutch friend who happened to celebrate a birthday during that time. Somebody from her own country sent her a vocal greeting recorded on an aluminium disc by one of the machines that ply for hire in many of the huge stores. This record, incidentally, caused me some loss of reputation, because it had to be reproduced by means of the wooden needles provided. With stacks of my own records

Wireless Activities for the Festive Season

and gramophone equipment around, it wasn't too easy to explain my total inability to let her hear this one. You see all my pick-ups happen to be of the rather exceptional needle-armature type!

This technical hitch is likely to occur with few, if any, of the friends to which one might send such a greeting and who are known to be within reach of a gramophone. But it may be necessary to mail by air to reach the more distant parts of the earth by Christmas.

It has been evident that a considerable number of *Wireless World* readers are interested, either practically or potentially, in gramophone recording of a rather more advanced description than that just mentioned. It is a hobby that one might well consider just now. "Free Grid" has, no doubt, more experience than I from which to suggest ingenious and possibly profitable applications of home recording.



Recording the family greetings.

Among less enterprising families, records of the ordinary commercial type achieve considerable popularity and help to create a cheerful atmosphere at parties and other festivities. But it is not always convenient to have to detail somebody to attend to the changing of them every few minutes; so now that automatic record changers have become reliable and not too expensive articles of commerce, they might well be put on the shopping list.

Talking about parties, another aid to the cheerful atmosphere just referred to is a mock broadcast. This may take the form of S O S or police announcements containing uncomplimentary descriptions of certain of the guests. The simple adaptation of a loud speaker that I described on October 29th last ("New Uses for Extension Loud Speakers") is quite suitable for this sort of thing, and it is also useful afterwards for enabling any member of the family whose constitution breaks down under the strain of the said parties to communicate from his sick-room with the folk downstairs through the medium of his extension loud speaker. The idea, briefly, is to introduce switching so that the extension speaker can be used optionally as a microphone.

Avoiding Interference

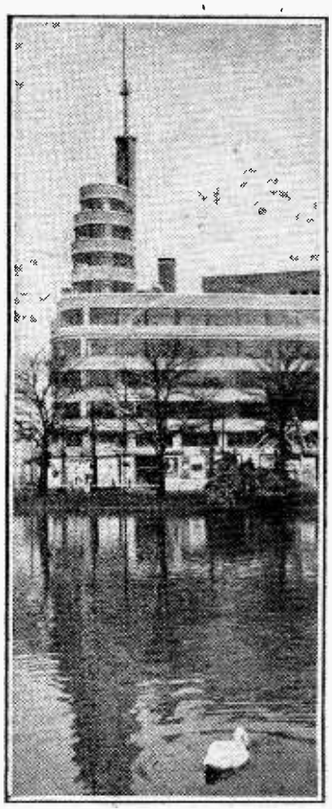
The suggestion that this is a good time for the disgrace hanging across the garden to be replaced by a proper aerial, preferably of the anti-interference type, may appear unseasonable. Although there may be a natural reluctance to leave the fireside in order to climb trees and chimney-stacks, there is no doubt that a little open-air exercise of the kind is a valuable corrective of certain symptoms closely associated with excessive indulgence in Christmas pudding. This is not the only benefit that may be expected to accrue from such a proceeding; a suitable anti-noise aerial is likely to give complete immunity from interference radiated by the miniature electric railway systems and the flashing arboreal decorations that are installed on all sides during the next week or two. And now that my old friend, F. R. W. Strafford, has revealed how such aerials really work, their erection may be carried out in a happier frame of mind.

The disadvantage of all the presents and purchases so far named is that although I have selected most of them for

What to do About Christmas—
their comparative inexpensiveness, they are not likely to be available at no cost at all. So those of us whose budget has no room for anything under the heading of Extra-ordinary Expenditure must be content with the absorbing pastime of designing a receiver exceeding the best that the most plutocratic person can obtain; one that is, moreover, free from the annoying breakdowns to which even the most costly apparatus is subject, and which presents no unexpected difficulties or fails to come up to expectations. The power transformer cannot catch fire, nor can the most violent storm of lightning strike it. For it exists only in the imagination. My subject next week may help with its design, for it concerns the relative merits of features that might be included in a really big set.

Current Topics

NEWS OF THE WEEK IN BRIEF REVIEW



Overlooking an artistically designed lake and park, the new Brussels Broadcasting House, which will be opened early next year, contains seventeen studios and provides facilities for utilising thirty programme channels.

New SW Station

IT has been decided to construct a 50-kW short-wave station on the outskirts of Vienna. It is hoped to begin the work next spring and to complete it within twelve months.

Radiophares

A WIRELESS beacon station has been opened at Filtvet, Norway. It operates on 942 metres and has a range of about 10 miles. The signal consists of three long dashes repeated at intervals of thirty seconds. Three other beacons are to be erected along the Norwegian coast.

Austrians to Pay More

THE decision to build a 50-kW. short-wave transmitter next year and the cost of the broadcasting headquarters at present nearing completion has forced the Austrian authorities to increase the licence fee of 2 Austrian schillings by 10 per cent., commencing next January. The Austrian Retailers' Association has already protested against this decision, as they fear it will spoil their Christmas sales of sets.

Vienna and Paris

THERE is a total of seventeen studios in the new broadcastings headquarters in Vienna. The largest of these can accommodate one hundred artistes and two hundred and fifty spectators. The completion of this building leaves only one important European capital, namely Paris, without a similar type of establishment.

Amateur Transmitters' Dinner

THE many "veterans" in the ranks of amateur wireless transmitters are to meet at an informal dinner which is being arranged for them by the Radio Society of Great Britain. All those who have held a licence for more than ten years are invited to communicate with the Secretary of the R.S.G.B., at 53, Victoria Street, London, S.W. No date has yet been fixed for the event, but it is expected that tickets will not cost more than 7s. 6d. each.

Radio Andorra Calling

COMPARATIVELY few people are aware of the existence of the small independent country of Andorra, which is situated in the Pyrenees between France and Spain. There are only 5,000 inhabitants in the whole country, but they have decided to make the voice of Andorra heard in Europe by building a 60-kW broadcasting station. It is thought in France that the station will be used for publicity purposes as in the case of the solitary station possessed by another very small country, namely, Luxemburg. The small independent countries of Liechtenstein and Monaco are reported to be considering similar schemes.

The North Pole Listens

THE party of Russian scientists who are wintering at the North Pole report particularly good reception of broadcast programmes. The complete absence of local interference largely accounts for these results.

Radio Aero Beacons

COMPREHENSIVE plans are being prepared by the French aviation authorities to equip aerodromes with the most up-to-date DF gear. It is stated that the French authorities have decided that in the matter of guiding aeroplanes by wireless they have nothing to learn from other European countries or from the U.S.A.

Delhi Headquarters

PLANS for the Broadcasting House of India to be erected in New Delhi are now nearing completion. The cost of the building will probably be about £23,000, a large part of which will be needed for air-conditioning. The transmitting station, which is to be erected in Delhi, will, it is estimated, account for another £23,000. The site chosen is at the junction of three main streets. It is hoped that the building will be ready by October, 1938.

DX on 5 Metres

NO really consistent long-distance work has yet been accomplished on 5 metres, such results as have been obtained being in the nature of freaks. With a view to encouraging experimental work on this waveband, an international transmitting contest is to be held among amateurs throughout 1938. It is particularly desired to encourage the use of CW on this band, and so ICW is to be ruled out. No contacts at less than 200 miles range will count for points. The contest is being arranged by the Radio Society of Great Britain.

Leipzig Fair

WIRELESS will again be very well represented at the famous Leipzig Spring Fair, which will be held from March 6th to 14th next year. This fair has been in existence for 700 years.

The Million Mark

BELGIUM is the latest country to join the ranks of those having more than one million licensed listeners. This follows hard upon the passing of the four million mark in France. In Czechoslovakia the million mark is being approached, and special arrangements are being made by the broadcasting authorities to celebrate the event in suitable form.

Indian Village Sets

RECEIVING sets which are being installed in 120 villages in the Delhi Province have been evolved as the result of work carried out in the research department of All-India Radio under the supervision of Mr. C. W. Goyder. The sets are fitted with an automatic time switch to turn them on and off and are designed to tune from 550-1,500 kc/s.

High Valve Prices

THE question of the unduly high prices of wireless valves has been raised in the Danish Parliament. A deputation of Danish set manufacturers has suggested to the Government that the best method of forcing valve prices down is to throw open the market to American valves, a measure which has proved abundantly successful in Norway and Sweden, where valve prices are only about half those ruling in Denmark.

The Radio Glide

SEVERAL American airports have installed, experimentally, new wireless beam apparatus to enable aircraft to land safely in thick fog. Its action is somewhat similar to that of the cable laid at the entrance to certain seaports along which a ship feels her way in foggy weather by the use of apparatus on board which indicates when she deviates to right or left of it. In this case a wireless beam is projected into the air and the pilot is enabled to feel his way carefully down this by means of suitable receiving gear.

Listeners' Guide for the Week

Outstanding Broadcasts at Home and Abroad

MORE and more use is being made of available material in the light entertainment world outside Broadcasting House.

During the week under review there are no fewer than four broadcasts from theatres and a cinema. John Watt, the Director of Variety, has planned a series of relays of variety shows from the stages of a number of London cinemas, which will be heard at regular intervals. On Tuesday we shall hear a programme from the Dominion Theatre, Tottenham Court Road, at 9 (Nat.). Among the artistes who will be heard are Jessie Matthews, the Western Brothers, Louis Levy and his Symphony, and Frederic Bayco at the organ. It is possible that relays from the Dominion will be a regular monthly feature next year.

For the other relays this week we shall visit the New Hippodrome, Coventry, to-night (Thursday) at 9.20 (Nat.); the Winter Gardens, Morecambe, on Saturday at 8 (Reg.); and the Palace Theatre, Blackpool, on Wednesday at 8 (Reg.).

ROYAL SALUTE

THE ROYAL SALUTE of 62 guns at the Tower in honour of the King's birthday on December 14th will be broadcast, with a description of the scene by John Snagge, for National listeners from 12.55-1.10. Four 13-pounders will be used by the Honourable Artillery Company to fire the 62 rounds at 10-second intervals.

An unusual problem faces the B.B.C. engineers in this broadcast, for the placing of the one microphone which is to be used both for the commentary and the gunfire cannot be determined beforehand. The reason, of course, why only one microphone can be used is that if a separate one were installed for the commentator listeners would hear what would appear to be two shots each time a gun was fired.

MARIE TEMPEST

BRITAIN'S leading comedienne, Dame Marie Tempest, is to take the tragic part of Mrs. Alving in Henrik Ibsen's "Ghosts" when it is broadcast this evening (Thursday) at 8.30 (Reg.) and again on Friday at 7.30 (Nat.). In doing so Marie Tempest will show that her art is far from limited to the interpretation of comedy. She has only once previously been heard in a full-length broadcast play in this country; that was when she played her original part of Judith in "Hay Fever" in July this year.

Henrik Ibsen first produced "Ghosts" in England in 1891, and the adverse criticism which it received was amazing. It is the story of puritanical humbug and is the most powerful play that Ibsen wrote.

THE RUSSIAN REVOLUTION

IN the space of one hour, one of the greatest upheavals of history will be set before listeners in its barest essentials. In this radio drama of the Russian Revolution, which Professor Temperley has prepared, the crisis will be viewed as a movement and as an historical drama.

It need hardly be said that there will be no propaganda included in this programme. The script includes quotations from the works of writers, soldiers and politicians representing all shades of thought in the Russia of the war period. It will be a study in which the facts and the actors in the drama will speak for themselves without any other comment than the interweaving narrative necessary to make the views intelligible.

Regional listeners will hear this programme on Monday at 9 and National listeners on Wednesday at 8.

MUSIC

THE Sunday evening Orchestral Concert which will be broadcast from a studio at 9.5 (Reg.) will be conducted by Dr. Malcolm Sargent. Paul Beard, the leader, and Robert Murchie, the principal flute, of the B.B.C. Symphony Orchestra, will be joined by Harriet Cohen (pianoforte) in Bach's Brandenburg Concerto No. 5 in D.

The distinguished French composer, Albert Roussel, whose death last summer at the age of sixty-eight was a great loss to contemporary music, will be commemorated on Tuesday at 8 (Nat.) in a memorial concert of his works which will be conducted by Sir Henry J. Wood.

COMPOSERS CONDUCTING

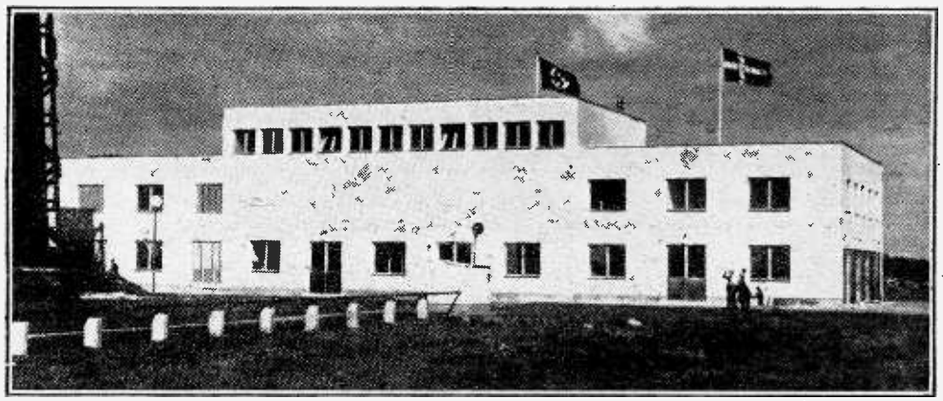
ON three occasions this week broadcasts from the continent will be of music conducted by the composers.

From Cologne on Friday at 8 we shall hear "Das Fürstenzimmer," an operetta for broadcasting conducted by the composer, Sieber.

Paul Lincke will conduct a concert of his music on Saturday at 7 which will be relayed from Bayreuth by Munich.

The Subscription Concert in the Salle Molière on Monday will be relayed by Lyons PTT at 8.45. The second part of the programme consists of a Darius Milhaud Festival conducted by the composer, who will also be soloist in his pianoforte concerto "Le Carnaval d'Aix."

THE AUDITOR.



LISTENERS to the Swedish transmitter Hörby will have noticed during the last few days an increase in its power. This 100 kW station, which is the third high-powered transmitter in Sweden and replaces the old 10 kW relay, was built by Telefunken.

HIGHLIGHTS OF THE WEEK

THURSDAY, DECEMBER 9th.

Nat., 7.40, Life in Lapland: a relay from Stockholm. 8, Music from the Movies.

Reg., 6.15, "Chalk it Up": a musical hot-pot. 8, Organ recital by C. H. Trevor. 8.30, Marie Tempest in Ibsen's "Ghosts."

Abroad.

Eiffel Tower, 8.30, Offenbach's comic opera, "La vie Parisienne."

FRIDAY, DECEMBER 10th.

Nat., 7.30, "Ghosts." 10.20, Dame Ethel Smyth's music.

Reg., 8, Variety from the Winter Gardens, Morecambe. 9, "Themes of London": a pot-pourri by Julius Buerger.

Abroad.

Strasbourg, 7.40, "The Mastersingers" from the Opéra, Paris.

SATURDAY, DECEMBER 11th.

Nat., 8, Palace of Varieties. 9.35, The Theatre Orchestra and Alfredo Campoli.

Reg., 8, B.B.C. Orchestra (D) and Louis Kentner (piano). 9.20, "Burbleton's Musical Festival."

Abroad.

Milan I, 8, Meyerbeer's opera, "L'Africaine," from the Royal Opera, Rome.

SUNDAY, DECEMBER 12th.

Nat., 7, Feature: William Blake—poet and painter. 9.5, Songs from operas by Jacques Offenbach.

Reg., 6.30, Recital: Tatiana Makushina. 7, Music of violinist composers.

Abroad.

Brussels I, 5, "A Trip through Switzerland": folk songs, etc.

MONDAY, DECEMBER 13th.

Nat., 7, Monday at Seven. 8.30, Broadway Matinée. 9.35, Amateur Ice Figure Skating Championships.

Reg., 6.15, Roy Fox and his band. 9, Radio drama of the Russian Revolution.

Abroad.

Lyons PTT, 8.45, Subscription concert from the Salle Molière.

TUESDAY, DECEMBER 14th.

Nat., 12.55, A Royal Salute for the King's birthday. 5, Louis Preil and his ensemble from Copenhagen. 9.40, Rhythm on the Roof: an American cabaret.

Reg., 7.30, Sea Shanties. 9, Variety from the Dominion Theatre, Tottenham Court Road.

Abroad.

Deutschlandsender, 7.30, Concert from the Philharmonie.

WEDNESDAY, DECEMBER 15th.

Nat., 8, The Russian Revolution. 9.20, Songs You Might Never Have Heard—winning songs.

Reg., 8, Variety from the Palace Theatre, Blackpool. 9.10, Midland Parliament: "Should Men and Women Get Equal Pay?"

Abroad.

Paris PTT, 8.30, Conservatoire concert relayed from Troyes.

UNBIASED

Festive Uplift

NOW that the annual doctors' and shopkeepers' benefit season is hard upon us once more, I suppose that all you fellows are being got ready by your wives and families to have the hard-earned cash which you so much want for those badly needed new wireless parts diverted to the purchase of the useless fripperies which usually grace—or, rather, disgrace—our breakfast tables on Christmas morning.

My memories of last Christmas are exceptionally bitter, and I can scarcely bear to think of them even now. Those of you who patronise Mr. Pelman will recollect that it was at this time last year that I was despatched on a wild-goose chase over the frozen wastes of the Great White North by a committee of women specially appointed by the Vicar. The object of my visit was to soak myself in the spirit of Christmas in readiness for the children's party held annually in the parish schoolroom. In the course of my journeying across the river Schnitzki-Gomitzcka to Lapland and other legendary haunts of Father Christmas, I picked up more chilblains and rheumatism than the spirit of Christmas, which I did not, as a matter of fact, get until my return home, when, by the doctor's orders, I had several stiff pegs of it.

The spirit of Christmas.

This year the same wretched Women's Committee decided that television is to figure on the programme of the party, and gave me peremptory orders to get on with the job, despite the fact that we were really outside the normal range of the Alexandra Palace. Notwithstanding my protests, I was ordered to do the best I could, and I decided that the first necessity, if we were to receive anything at all, was a good high aerial. With this end in view, therefore, I attempted to sling a rope over one of the topmost branches of a singularly high and unclimbable fir tree which grew in the Vicarage grounds.

The Voice of the Tempter

I first tried the old dodge of tying a heavy stone to a clothes line and whirling it round and round before letting it fly. Unfortunately I had omitted to allow for the effect of centrifugal force in my mathematical calculations, and after breaking a few panes of glass in the hothouse in which the Vicar was rearing some particularly choice orchids, I decided to call it a day so far as this method went.

In a moment of weakness, I listened to the voice of the Tempter in the shape of a youthful son of the house, who had a large number of fireworks left over from Guy Fawkes day, and went into a long dissertation on how he had been taught in his local Boy Scouts troop to use these for the purpose of slinging the necessary halyards for flying signals of distress from tall trees in case he ever got wrecked on a desert island. It seemed to me a little unfortunate that the local scoutmaster had omitted to explain how to make rockets out of the material available on desert islands, but to my surprise my self-appointed assistant explained that this had not been forgotten, the only thing that was necessary being the gunpowder which, so it appears, always gets saved from the wreck, as it did in the case of Robinson Crusoe.

My somewhat forcibly expressed remarks concerning the scoutmaster were possibly a little hasty and unkind, although I don't think that they were unjust. Had we proceeded to use the ordinary commercial rockets all might have been well, but unfortunately my assistant, stung by my sarcastic remarks about his scoutmaster, insisted on making some himself, which he did with the aid of some old cardboard tubes used for packing rolled-up pictures, and a quantity of gunpowder purchased at the village store.

The most charitable thing to suppose is that my youthful helper was not as particular as he might have been in following the exact figures of the formula given by his scoutmaster. At any rate, when we tried them out that evening, after one or two abortive attempts, in which the rockets fizzled miserably out, one of them suddenly went into action with a totally unexpected roar and zoomed skywards, trailing what looked like a miniature Vesuvius behind it as well as the aerial rope.

I can only think that in my anxiety to get the rocket off I had not noticed that one of my feet was entangled in the end of the aerial rope. At any rate, before I realised what had happened I found myself yanked violently into the air by one ankle. Had it not been for the fact that the previously mentioned Vesuvius-like trail of fire behind the rocket burned through the rope at the psychological moment I should probably have found myself caught up in the branches at the top of the tree. As it was, after soaring skywards for a few hectic moments I came down to earth again very violently, and might have sustained serious injuries had not a member of the Women's Committee happened to be passing at the moment.

A Narrow Squeak

As in the case of the electron hitting the cathode-ray screen, the resultant collision with her as I came down from above led to a certain amount of fluorescence, and since then we have not been on speaking terms. I offered to forward a written account of her gallant act of life-saving to the Royal Humane Society, but she somewhat tartly informed me that the R.S.P.C.A. would probably be a more fitting recipient for my letter. Eventually we did manage to get the aerial fixed by the timely help of the fire brigade from the nearest town, this being made possible owing to the fact that one of the firemen happened to be foolishly contemplating involving himself in matrimonial entanglements with a female member of the Vicar's domestic staff.

Just as I had told the committee beforehand, I found that in spite of a really lofty aerial we were completely out of normal range, and the result is that with the party only a few day ahead I am left to get out of the mess. The committee still insists on providing some sort of television show and have now decided that I shall install a low-power transmitter and get some of the budding Irvings and Mrs. Siddons of the village to do their stuff in front of it for the edification of their fellow creatures at the receiving end in the neighbouring schoolroom. Although I have my misgivings about the idea, I have, nevertheless, definitely undertaken to carry it out, and am at present engaged in studying the catalogues of the makers of television transmitting gear. I am, however, by no means looking forward to the party.

My foot was entangled.

Yuletide Broadcasts

FEATURES OF THE HOME PROGRAMMES

The skyline of Bethlehem, with the tower of the Church of the Nativity on the left, is shown above. The Christmas atmosphere in Bethlehem will be conveyed to listeners in a relay on Sunday, December 26th.

THAT the listening public in general should be dissatisfied with anything in the nature of Christmas broadcasts that do not even pretend to be outstanding is little wonder. When the B.B.C. decided not to give the "Round the Empire" broadcast last year it was taken in good part for it was realised that it was a wise move, because, without His Majesty's message to the Empire, it would be unfinished.

After perusing the advance programme arrangements for the festive season and finding little in the nature of high spots, the matter was mentioned to a B.B.C. official. His reply was, "Is it that the programmes *are* dull or that listeners are becoming blasé?" There is, of course, a lot to be said for this point of view when speaking of broadcast programmes in general but there is little doubt that listeners *do* expect something outstanding for the one holiday in the year when all are indoors.

That the "Round the Empire" hook-up was eagerly awaited and enjoyed because it gave that feeling of unity with the far corners of the world which is inherently the spirit of Christmas, is amply borne out by correspondence. It is therefore regrettable that something in the nature of a similar programme could not have been devised to take its place. However, the well-tried perennials are again in full bloom.

The festival of nine lessons and carols which is held in King's College Chapel, Cambridge, every Christmas Eve, and is, perhaps, the most beautiful carol service to be heard, will again be broadcast for National listeners in the early evening. Although built as far back as 1440, the Chapel is possibly the church best suited to broadcasting in this country for it is acoustically almost perfect. Later on Christmas Eve, what has become known as the "B.B.C.'s Carol Service" will be broadcast from the Churchyard of St. Mary's, Whitechapel. The carols will be sung by the B.B.C. Singers supported by members of the Military Band.

"The Keeping of Christmas" is the title given to an interesting and informative programme which will occupy seventy minutes (rather too much at a stretch!) of the National programme on Christmas evening. It will present a bird's-eye view, by description and music, of traditional Christmas customs of Europe and the Mediterranean Lands.

One of the most outstanding things about the annual two-hour "Party" which National listeners are asked to join on Christmas evening from 7-9, is the atmosphere of spontaneity which prevails. This is *the* most informal broadcast of the year, for although the artistes are invited well in advance it is not until Christmas morning that they all meet in St. George's Hall and plan the actual order for the party.

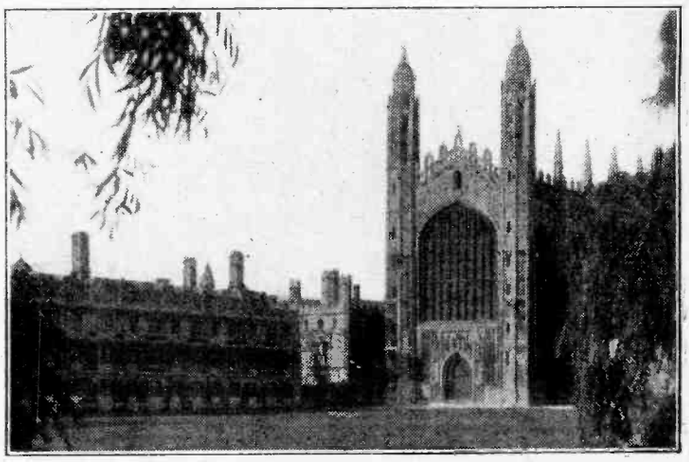
A few years ago the fact that the Bells of Bethlehem were to be broadcast would have been shouted from the housetops, but such is the advance of radio that the broadcast on Sunday (December 26th) of the bells and service from the Church of the Nativity will be taken as a matter of course. After the bells which will open the broadcast, a commentator stationed on the old Crusader Wall overlooking the Church of the Nativity, from which point he will have an excellent view of Bethlehem, will give a description of the scene in the town. A microphone in the church will pick up the singing of the Latin Choir, following which comes a description of the church itself and of the grotto of the Nativity. The transmission will be via land-line to Cairo and thence by beam wireless to England.

Boxing Day is a day of sport for many people, and the sporting spirit has not been omitted from the day's programmes. Two Ice Hockey matches will provide commentaries in the afternoon and evening. "International Sport of the Year" is the title of a programme of excerpts from sports commentaries given during the year which will be radiated Nationally in the evening. Sections of recordings are being used, and these will be linked by connecting phrases and placed on a master record. In this way a cross-section of the high-spots of big sports commentaries of the year will be given.

Both on Christmas Day and Boxing Day Regional listeners are being given opera relays. The first comes from the Prague National Theatre, and will consist of the third act of Smetana's "The Bartered Bride." Monday's relay is of Act IV of Bizet's "Carmen" from Vienna.

Although intended for the children, some will want to hear Philip Wade's adaptation of Dickens' "A Christmas Carol" which will be broadcast Regionally on Christmas Day.

The times of the individual programmes will be given in "Listener's Guide for the Week" in the issue of December 23rd.

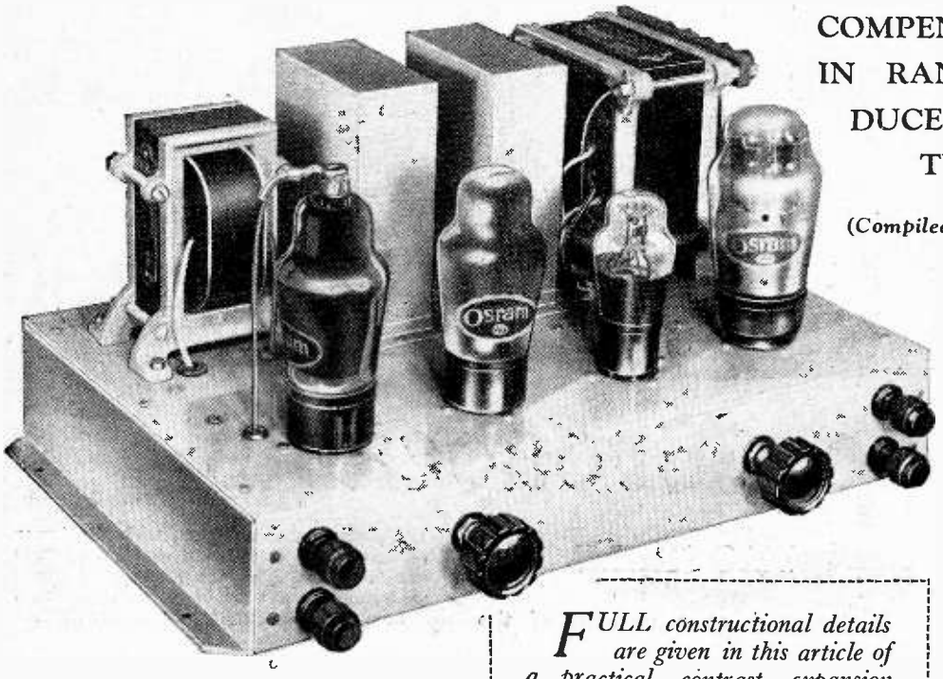


One of the glories of King's College Chapel, Cambridge, whence its famous choir will sing carols on Christmas Eve, is its almost perfect acoustics.

Contrast Expansion Unit

COMPENSATING FOR COMPRESSION IN RANGE OF INTENSITY INTRODUCED DURING RECORDING OR TRANSMISSION OF MUSIC

(Compiled from information furnished by the G.E.C.)



FULL constructional details are given in this article of a practical contrast expansion amplifier which embodies the essential features of the scheme described in last week's issue. This unit is entirely self-contained, is AC mains operated and provides its own power supply.

As was explained last week, the idea behind contrast, or volume, expansion is to provide a means whereby music, and particularly recorded music, can be reproduced with the correct relationship between soft and loud passages.

Whilst volume expansion will, in many cases, improve the reproduction of actual orchestral performances in the broadcast programmes, its most marked effect is probably noticed on recorded music, for in making gramophone records it is usually necessary to compress the range of intensity in order to avoid breakdown between adjacent grooves.

The amount of compression depends, of course, on the particular piece of music—some will require more than others—so that an amplifier in which contrast expansion is included should have provision for varying the degree of expansion introduced into the reproduction. The same can be said of broadcasting.

A practical circuit designed to restore the natural intensity of loud passages while yet retaining the soft at a high enough level to ensure their predominance over the inherent background, or surface noise in the case of records, is shown in Fig. 1.

It is intended that the contrast expander be built as a separate unit, for in the form shown it does not lend itself conveniently for embodying in existing amplifying equipment.

Volume expansion will not, of course, accurately compensate for all amplitude limitations in recordings, since the original compression may not be strictly linear, whereas in designing the expander every care has been taken to make its action strictly linear. That is to say, the output from the expansion amplifier—in this case the Osram heptode type MX40—bears a

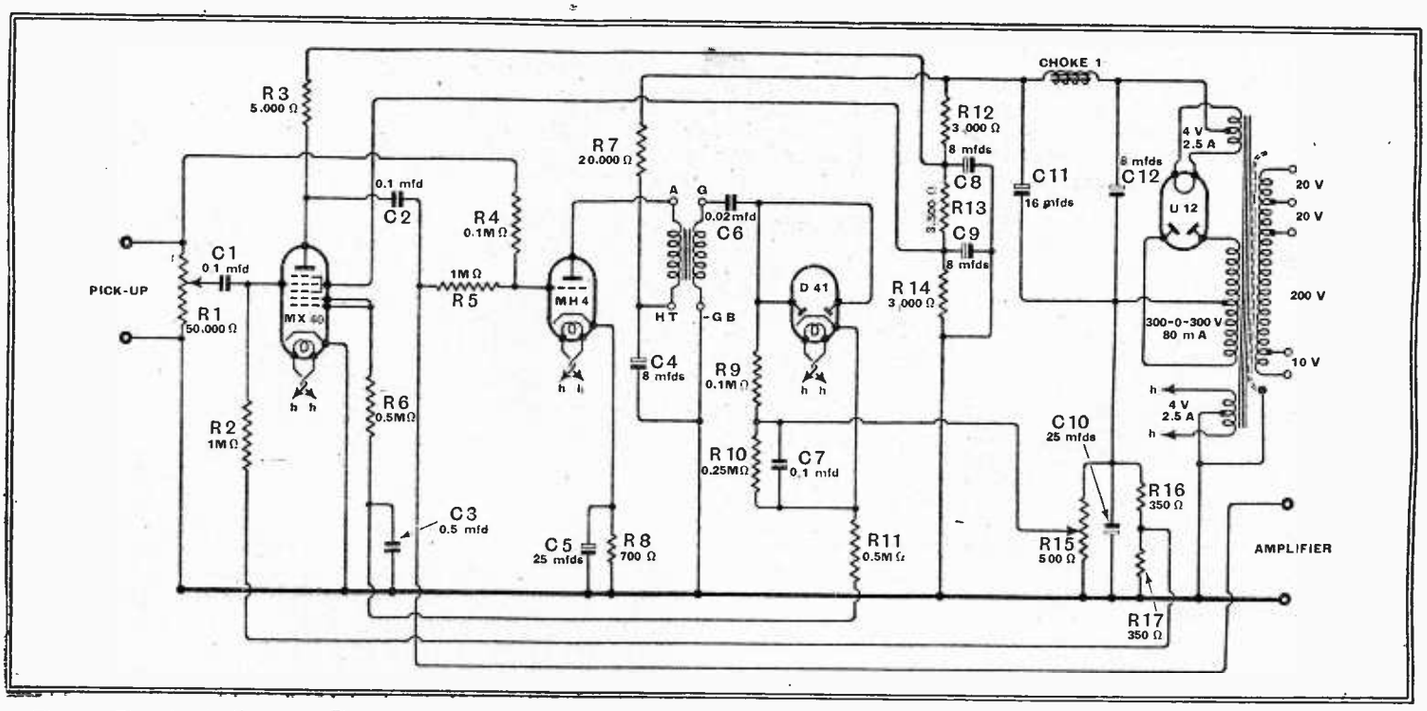


Fig. 1.—The circuit diagram. The component reference letters and numbers afford an easy identification to the parts shown on the practical wiring diagram.

Contrast Expansion Unit—

linear relationship to the strength of the signal applied to its working grid.

The amount of expansion, i.e., the contrast between soft and loud passages, is, however, controllable, it being effected by the potentiometer R15.

The two inner grids of the MX40 are strapped together and given a negative bias which is derived from this potentiometer as it is joined across two fixed resistors R16 and R17 connected between the negative HT and the earth line.

Biasing these grids negatively lowers the gain of the valve, so that it only needs some means of varying this bias from full negative to zero to obtain a variable-gain amplifier. If the strength of the signal on the working grid can be made to counteract this initial bias, the output from the valve will vary in accordance with the strength of the incoming signals.

Control Circuit

This is the basic action of the expander, and the positive voltage to offset the negative bias on the inner grids is provided by the Osram MH4 amplifier and the D41 rectifier.

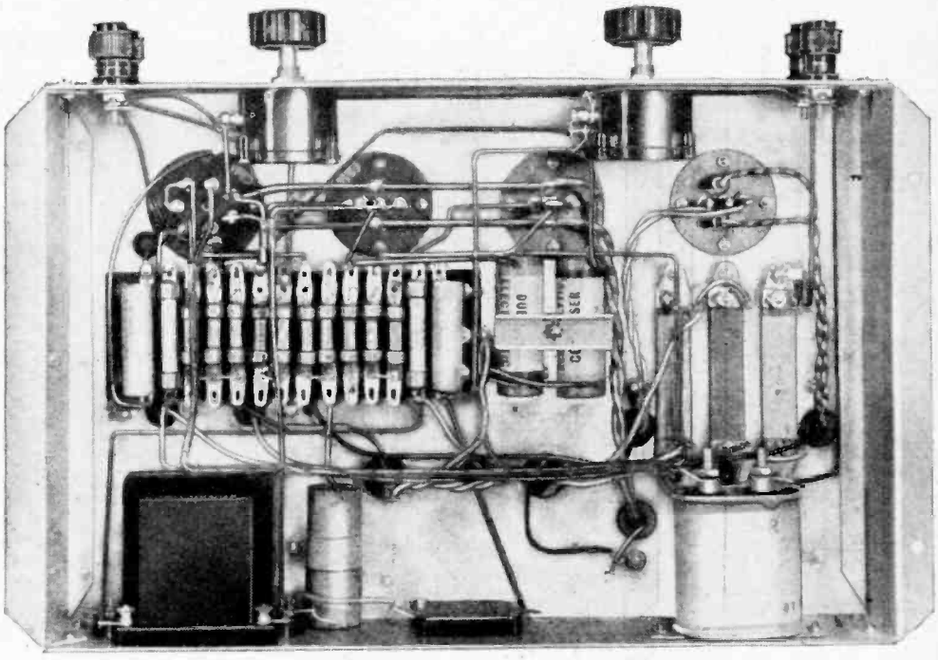
Though an amplifier, the MH4 valve functions only in connection with the D41, for the changes in signal intensity would not normally be sufficient to enable the rectifier to supply an adequate positive voltage.

The output from the pick-up is applied to the normal signal grid of the MX40, the volume control R1 serving only to limit the input to the valve to prevent overloading. It is not a volume control in the true sense, and it must not be used as such.

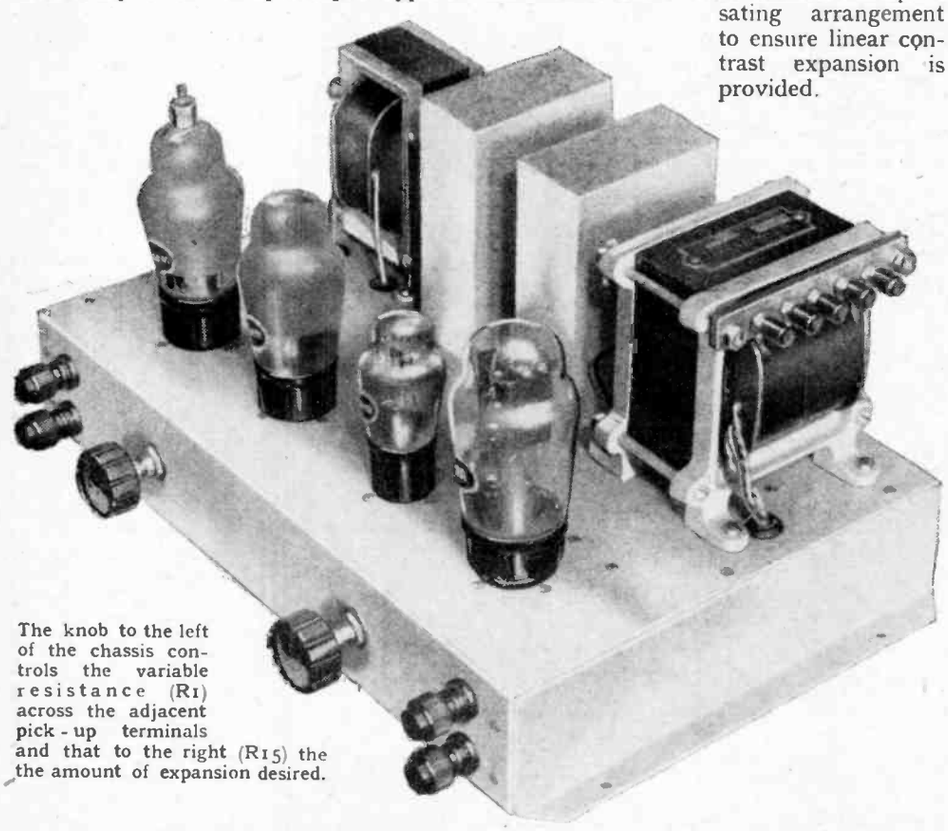
Control of volume has to be effected *after* the expander, and for preference at the input of the main amplifier.

As will be seen from Fig. 1, the signal is applied to the rectifier circuit from the high potential end of R1; its input is thus independent of the magnitude of the signal on the grid of the MX40.

A feature of this unit is that a compensating arrangement to ensure linear contrast expansion is provided.



The tubular condenser C3, and the pair C5, C10 are secured to the chassis by means of small metal clips.



The knob to the left of the chassis controls the variable resistance (R1) across the adjacent pick-up terminals and that to the right (R15) the the amount of expansion desired.

The MX40 valve, when used as a variable gain amplifier in the manner described, has a linear characteristic over a certain range of control voltages; then it shows a tendency towards non-linearity, and with very large control voltages there is a return to straight-line operation.

In order to flatten this curvature in its characteristic a compensating arrangement comprising the resistances R4 and R5 has been included. Its function is to reduce the input to the rectifier amplifier, the MH4 valve, when the output from the MX40 attains a certain level. Were the resistances omitted, the change from linear to non-linear operation would become apparent by sudden bursts of volume instead of the desired progressive increase as shown by the curves in last week's article describing the basic principles of this expander.

The values of R4 and R5 have been carefully chosen to give the correct operation.

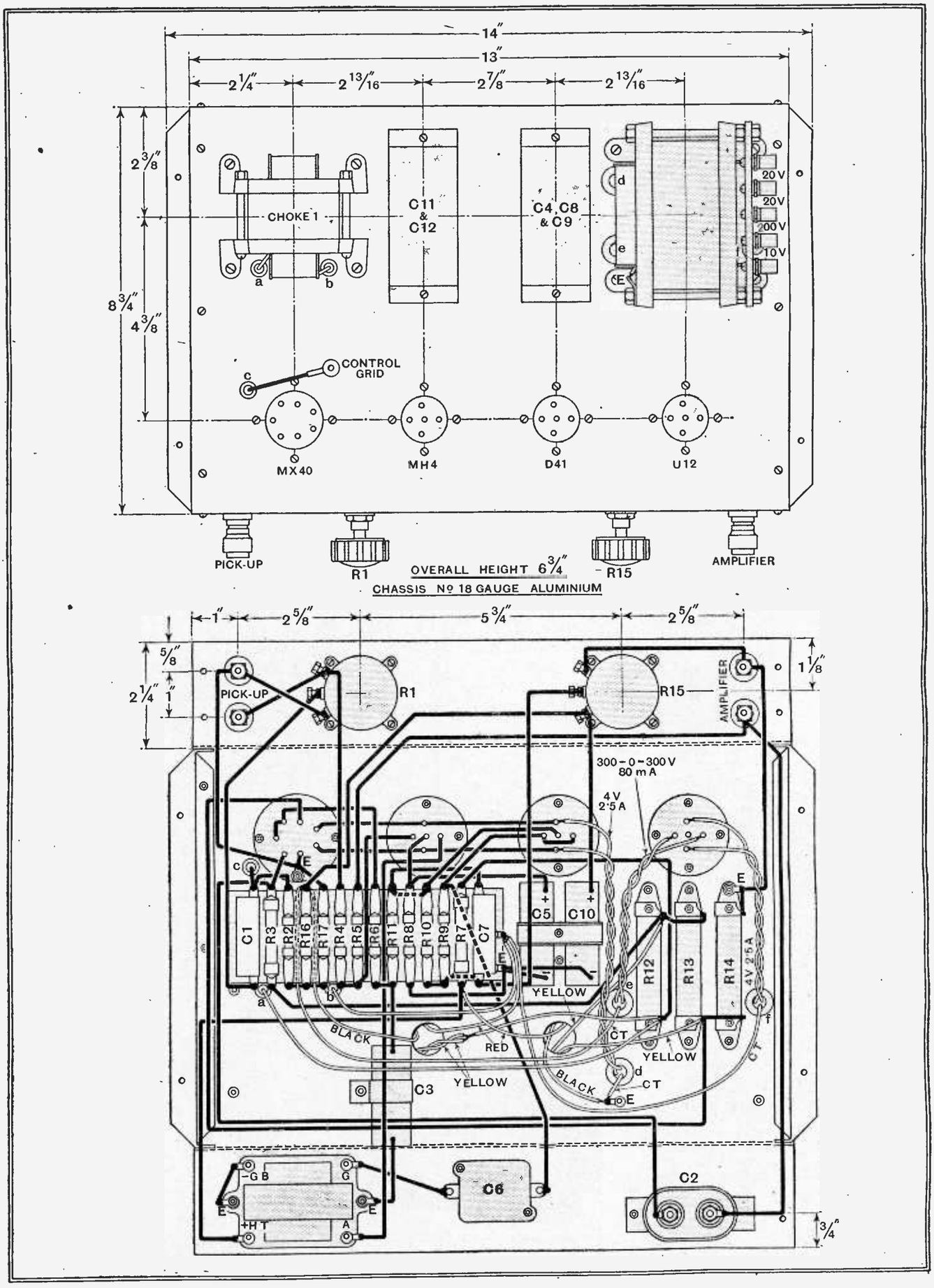
Power Supply

Owing to the fact that the chassis, which is indicated by the "earth line" in the theoretical circuit, is not joined to the HT negative direct but via the negative bias resistance network R15, R16 and R17, it is almost essential to use a separate power supply for this unit. By separate it is meant that the power pack should not be common to this and any other part of the amplifying equipment.

Accordingly, it was decided to include the power supply in the contrast expansion unit.

As already explained, there are only two controls on the unit, and of these only one will be used to any extent. This is the expansion control R15. The MX40 input control R1 will require very little adjustment once the position for best operation is found. Of course, if the gramophone pick-up is changed, then a new setting for R1 may be necessary.

Incidentally, it should have been mentioned that the signal grid of the MX40 has a small negative bias. It is obvious from examining the circuit, of course, as



The wiring diagram. It will be noted that whereas the units of the triple condensers C4, C8 and C9 are used separately, two units of the companion condenser are joined together to form C11 (16 mfd.), while C12 is the remaining unit.

Contrast Expansion Unit—
the low-potential end of the grid leak R2 is joined to the junction of the two 350-ohm resistances R16 and R17, which are connected between the HT and the chassis. A grid bias of about − 3 volts is obtained from this source.

Whilst the correct adjustment of R15 for normal operation could be found simply by listening to the reproduction and, if necessary, adjusting R1 should overloading of the MX40 be suspected, a better way would be, perhaps, to join a milliammeter in the anode circuit of the valve and adjust the initial bias on the inner grids so that with *no input* the steady anode current is about 0.5 mA.

When the expander is in operation the anode current will rise to about 3 or 4 mA on loud passages.

THE LIST OF PARTS USED.

Certain components of other makes but of similar characteristics may be used as alternatives to those given in the following list.

1 Mains transformer, Primary: 200-250 volts, 50 c/s. Secondaries: 300-0-300 volts, 80 mA; 4 volts, 2.5 amps. C.T.; 4 volts, 2.5 amps. C.T.
Rich and Bundy Model No. 5
1 Smoothing choke 20 H., 50-60 mA
Rich and Bundy Model E122
1 Intervalve transformer 1:3.5
R.I. "Dux" DY29
Condensers:
2 8-8-8 mfds., 570 volts working, electrolytic, **C4, C8, C9, C11, and C12**
Dubilier 3229
2 25 mfds., 25 volts, electrolytic, **C5, C10**
Dubilier 3016
1 0.5 mfd., 350 volts, tubular, **C3**
Dubilier 4608/S
2 0.1 mfd., 350 volts, tubular, **C1, C7**
Dubilier 4603/S
1 0.1 mfd., 1,500 volts, oil-immersed, **C2**
Dubilier 950A
1 0.02 mfd., 350 volts, mica, **C6**
Dubilier 680
1 Volume control, 500 ohms, **R15**
Haynes Radio
1 Volume control, 50,000 ohms, **R1**
Haynes Radio
1 Valve holder, 4-pin (without terminals)
Clix Chassis Mounting Standard Type V1
2 Valve holders, 5-pin (without terminals)
Clix Chassis Mounting Standard Type V1
1 Valve holder, 7-pin, (without terminals)
Clix Chassis Mounting Standard Type V2
Resistances:
2 350 ohms, ½ watt, **R16, R17**
Bulgin HW40
1 700 ohms, ½ watt, **R8** **Bulgin HW41**
2 100,000 ohms, ½ watt, **R4, R9**
Bulgin HW25
1 250,000 ohms, ½ watt, **R10**
Bulgin HW28
2 500,000 ohms, ½ watt, **R6, R11**
Bulgin HW31
2 1 megohm, ½ watt, **R2, R5**
Bulgin HW33
1 5,000 ohms, 1 watt, **R3** **Bulgin WE1**
1 20,000 ohms, 1 watt, **R7** **Bulgin WE3**
2 3,000 ohms, strip type, **R12, R14**
Colvern
1 3,500 ohms, strip type, **R13** **Colvern**
4 Terminals, ebonite shrouded, Output+, —, Pick-up (2) **Belling-Lee "B"**
1 Plug top valve connector **Belling-Lee 1175**
Chassis 13 × 8¾ × 2½ in. **Haynes Radio**
1 Resistance group board **Haynes Radio**
Miscellaneous: **Peto-Scott**
3 lengths systoflex, small quantity No. 16 and No. 20 tinned copper wire, 6 rubber grommets, etc.
Screws: 36 ½in. 6 BA; 10 ½in. 6 BA; 8 ½in. 4 BA; 4 ¾in. 4 BA; 1 1¼in. 6 BA, all with nuts and washers.
Valves:
1 MH4, 1 D41, 1 MX40, 1 U12 **Osram**

The correct place for the meter is not at the anode of the valve, but in the lead that normally joins R3 to the junction of R12 and R13, the lead being disconnected from R12, R13 for this purpose.

Though it has been mentioned that the unit might possibly find an application in broadcasting, it is emphasised that its principal usefulness is in connection with gramophone reproduction.

With contrast expansion the output stage of the main amplifier may occasionally be required to handle a comparatively large input, and unless it is capable of doing this without introducing distortion the advantage accruing from contrast expansion will be lost.

The smallest output stage that is likely to be satisfactory for this purpose is two PX4-type valves operating in push-pull.

It is not proposed to discuss the actual construction of the unit, as it is quite straightforward and does not require comment, save perhaps to mention that of the three 0.1 mfd. condensers one is an oil-immersed model and is used in the position C2. The practical drawings and the wiring plan give all the essential information.

The design of the unit best suits the magnetic-type of pick-up giving an average output of between 1/20th and 1/5th volt.

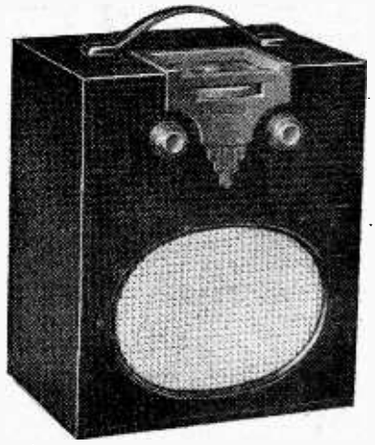
Very good results can be obtained with the piezo-electric type, but the transformer after the MH4 valve should be replaced by a low-gain resistance capacity coupling.

Cossor's First Portable

A Straight Battery Set with Automatic Bias

THE Model P44, as this new product of A. C. Cossor, Ltd., is called, is housed in a neat black leather-finished case, measuring 12¾ × 10¼ × 7⅜in., and fitted with a ball-bearing turntable in the base. The main tuning control is a knurled edgewise disc carrying a circular scale calibrated in metres and with station names.

A 6in. permanent magnet loud speaker is



Cossor Model P44 battery portable.

fitted, and a special plug enables the built-in loud speaker or an extension loud speaker (or 'phones), or both, to be used. The circuit consists of a pentode RF amplifier, pentode detector with combined reaction and volume control, triode first AF amplifier, and a high slope pentode or tetrode output valve. Grid bias is automatic, and there is provision for an external aerial and earth. The price, which includes batteries, is £6 19s.

First International Five-Metre Contest

IN order to investigate the potentialities of the ultra-high frequencies for long-distance communication, the Radio Society of Great Britain have organised a contest commencing on January 1st and concluding on December 31st, 1938.

Transmitting stations participating must adhere to the terms of their licence in regard to wavelength and power, but only CW is permitted, modulated CW of any kind being disallowed.

Points will be awarded on the following basis:

1 point for each contact over a distance between 200 and 1,000 miles.
5 points between 1,001 and 2,000 miles.
10 points between 2,001 and 3,000 miles.
15 points between 3,001 and 4,000 miles.
20 points between 4,001 and 5,000 miles.

And so on at the rate of 5 extra points for each 1,000 miles or part thereof.

All distances to be calculated by Great Circle.

At all times the transmission and reception must be effected from the fixed position from which the station is licensed to operate.

Concurrently with the transmitting contest the R.S.G.B. have decided to hold a receiving contest provided a sufficient number of entries are received.

In addition to the award of trophies in each section, certificates of merit will be awarded to those submitting the most valuable information at the conclusion of the contest.

Full particulars and rules can be obtained from the headquarters of the R.S.G.B., 53, Victoria Street, London, S.W.1.

Short-Wave Radio. By J. H. Reyner, B.Sc. 159 pages and 83 illustrations. Published by Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, London, W.C.2. Price 8s. 6d.

THIS book has been written primarily for the student of short-wave technique, it having been assumed that the reader possesses a fair knowledge of ordinary wireless theory.

It includes a useful glossary of technical terms, a concise definition of the short, the ultra-short and the micro-waves, and a short chapter on wave propagation.

In view of its general importance, especially on the short waves, considerable space is devoted to aerials, aerial arrays and feeders, these subjects occupying about one-quarter of the book.

In the remaining chapters transmission, reception, ultra-short waves and micro-waves are dealt with, and though in some cases the space devoted to them may seem small by comparison with that taken up by aerials, since only fundamental principles are discussed, the treatment is adequate.

As it is impossible in a book of this size to deal fully with every aspect of the short waves, the author has included suitable references for the benefit of readers requiring more detailed information on any particular subject.

Random Radiations

By "DIALLIST"

World Services

THE B.B.C. is going right ahead with its plans for broadcasts in foreign languages, which should be starting fairly soon now. They have advertised for people with a knowledge of Spanish, Portuguese and Arabic, so presumably it is in these three languages that broadcasts will be made at first. The choice is, I believe, a good one. Plain statements of fact in Spanish and Portuguese should help greatly by bringing our standpoint and outlook to the inhabitants of the South American countries, where our reputation may have suffered owing to the propagandist activities of certain other nations. The fact that hitherto we have said nothing, however much we may have been traduced, has too often been taken as proof that we have nothing to say. It is much the same in the Near East and in parts of Africa where Arabic is the common tongue. Straightforward news bulletins from Daventry will help a great deal there as well. The pity of it is that anything of the kind should be made necessary. But there it is.

For This Relief

MOST of us are probably relieved to hear that the proposal that Parliamentary debates should be broadcast did not materialise. I imagine that those who were keen on having them relayed can never have spent much time in the House of Commons as occupants of the Strangers' Gallery. Those who have must realise that proceedings in Parliament wouldn't go down very well over the wireless. Most of the debates are far too long drawn out, and you have to listen to an unconscionable amount of dreary stuff as a rule in order to light upon something really worth hearing. The only possible way to work Parliamentary broadcasts would be to have no special timetable, but to fade-out the ordinary programme and fade-in the House of Commons when something out of the ordinary was taking place. I don't think that this kind of thing would commend itself very much to the majority of listeners.

Are Our Programmes Poor ?

SOME of the wireless manufacturers have been dealing the B.B.C. some hard knocks of late, laying upon it the whole blame for the public's being none too keen to buy new receiving sets. The programmes, they say, are so dreadful that people aren't attracted by wireless as they ought to be. I am not saying that the programmes are perfect, though I do honestly feel that the B.B.C. tackles the difficult job of providing millions of people with radio entertainment better than their opposite numbers in most, if not all, other countries. One of the big difficulties is that tastes differ so enormously. Masses of people clamour for more and ever more "Variety." Others can never have too much light music. Yet others would have hardly anything but dance bands, whilst others, again, want classical music or plays or feature programmes or talks in large quantities. Taking things by and large I can't help feeling that the B.B.C. does all of us pretty well. And if there is nothing particularly good in our view from the home stations we can always go abroad with the modern set. There must, I suppose, be at least a score of alternative programmes available to anyone who has a set worthy of the name nowadays. But comparatively few listeners make any regular use of foreign stations. This fact alone is sufficient to show that the home programmes aren't too bad.

Quite Another Reason

My own explanation, for what it is worth, of the fact that sales of new sets have not been so brisk as they might have been is rather different. I'd say that there are two chief causes. The first is that the part-exchange value of the existing set is too small to be tempting; the second, that there is too little superiority in the performances of new sets over those of one or two years ago to make it obviously worth while to turn in an oldish set, which is doing quite well, at some very small price against the cost of a new one. After all, if you are going to pay a moderate price only, or in other words to buy the popular set of to-day, what has the new model to offer? To be brutally frank, it's too often much the same old works in a new box. True, the contents of the new box may be tuned in novel ways and possess quite a few fresh gadgets. But the acid test of a set is twofold: Does it receive the local stations with better quality, and does it receive more stations all told? Even if the answer to both of these questions is in the affirmative, the improvement has to be very marked to induce the owner of a not-so-old receiver to part with it at what is almost a break-up price in order to install a new model.

It's Valves as Does It

A LONG time ago I predicted that if our industry concentrated on the superhet with about four "working" valves as distinct from the mains rectifier, the time must come when, gadgets apart, you couldn't go much further. Well, it seems to me that that time has come. Instead of educating the public up to the real advantages of the set containing a greater number of usefully applied valves, manufacturers have been content to lead it to believe that everything that the listener can desire can be provided by a small number. I can say from the experience of one who has to deal every week with a very large correspondence that the average listener, whether he has a mains or a battery set, is frightened by the receiver containing more than three, four or five valves because he fears that both running costs and the cost of valve replacements may be excessive. If only steps had been taken to show the man in the street how small running costs need be with the bigger mains set or its battery counterpart, provided that batteries of good quality and adequate capacity are used, this "phobia" would have finished long ago. Valve replacements are, of course, in a different category. So long as valves are sold at high prices and with only a three months' guarantee the public must naturally be nervous of the bigger set.

Overdoing It ?

I AM left wondering when I see that a firm of importers of American valves proposes to give a guarantee of twelve months' service for their "toobs." The firm in question states that under the old three months' guarantee returns have worked out at less than 1 per cent. Accepting that figure which, after all, is about what it should be, one feels that even the most confirmed non-stop wireless listener (or should one say non-stop, non-listening wireless user?) must get his full money's-worth from his valves in something far less than a twelve-month. Unless he is prepared to put up with poor performance on the RF side of

SEAPLANE TENDERS of the German Air Force have recently been fitted with medium- and short-wave transmitters (500-1000 and 50-100 metres) and direction-finding gear for use in locating aircraft in distress at sea. In the above photograph can be seen the DF loop and the transmitting and receiving aerials.

Random Radiations—

his set and distortion on the LF side, I can't see that the man who makes a great deal of use of his receiver can expect more than from six to nine months' service from the best valves going, if they are made on a thousand-hour service life basis. A six-months' guarantee would probably be fair all round. One of twelve months may be going rather too far, unless valve makers are prepared to design their valves for a service life of much more than a thousand working hours.

Something Like a Dial

RECENTLY I groused about the crowded nature of certain tuning dials on the short-wave range; and that some of them *are* crowded many readers must know by bitter and exasperating experience. Messrs. Ferranti write to me to say that apparently I don't know their "magnoscopic" dial. I do. I do. And I have nothing but praise for it. It is a most ingenious arrangement, employing an "optical" lever, which gives you a scale marked off from 0 to 180 degrees that is equivalent to an effective length of over six feet. It is easy to read and provided that you let the set warm up properly before you start to jot down readings, you can return with no trouble at all to a short-wave station whose setting has been recorded.

Another Awful Word

IN a recent announcement to the wireless trade, one of our big manufacturing firms, which rather prides itself on the quality of the reproduction of its sets, strikes one of those blows to the beauty of the language from which English suffers so often and so undeservedly. "No new models," says the firm, in cold hard print, "obsoleting current types will be introduced . . . ." Obsoleting! Did you ever come across a more horrible monstrosity produced in connection with wireless? May one express the hope that the culprits will take steps to ensure that less linguistic distortion occurs in future in the output of their circular-producing departments?

DISTANT RECEPTION NOTES

NOT long ago I predicted that Sofia, the new 100-kilowatt Bulgarian station, might be of no great use to listeners in this country, since other stations sharing the same international common-wave channel are Bodo (10 kW), Porsgrund (1 kW), Stavanger (10 kW), and Valencia (3 kW). I see that in another wireless publication there is a letter, obviously referring to this forecast, which states that its writer is able to obtain good reception from Sofia.

He's lucky! I can't, as a rule. It's true that you can hear Sofia easily enough if you don't mind a low-pitched heterodyne as a background. But it's hardly the kind of reception that you care to listen to for pure entertainment. And when Valencia, which was never conspicuous as a strict keeper of wavelengths, strikes up the interference is rather more than you, or at any rate I, can endure. It is a pity, for if it weren't for these handicaps Sofia would be well received in this country, and the programmes that I have heard from it seem to be bright and entertaining.

Genoa No. 2 is another station whose failure as a provider of entertainment in this country I was bold enough to forecast. Just occasionally it comes through fairly well; but as a rule common-wave wobble and interference make it of small value.

The new medium-wave Dutch station at Lopikerkapel (Hilversum No. 3), which still modestly describes itself as "testing," is usually to be found going strong after dusk. A kind Dutch reader tells me that the output power is in the neighbourhood of 20 kilowatts, though the transmitter has been so constructed that there is plenty more in reserve if the long tests are eventually voted successful.

I am afraid, though, that the coming of the new 120-kilowatt Rome No. 1 may prove a serious stumbling-block. Though it hasn't yet appeared in the official lists, the new Rome transmitter appears to be at work, judging by the big signal strength on 420.8 metres. Previously, Rome No. 1 and Hilversum No. 3 seemed to be getting on quite well as wavelength neighbours. But now the Dutch station is seldom free from sideband splutter, and at times a poisonous heterodyne is strongly in evidence.

Since it so frequently transmits the programmes of Hilversum No. 1, I imagine that the idea of the Dutch authorities in building the transmitter at Lopikerkapel was to erect a station working on the medium waves which would be able to give Holland, without interference, the programmes that have been radiated on 1,875 metres, but spoilt by the strong background from Radio-Romania.

It will be very hard luck if the 120-kilowatt Rome transmitter makes things just as bad for the Dutch broadcasting authorities on the medium waves. However, a correspondent who has recently visited Holland tells me that a wavelength in the neighbourhood of 500 metres is visualised eventually for Hilversum No. 3.

The mention of Rome reminds me that I have had an official list showing the recently revised grouping of the Italian stations sent to me. This shows nineteen transmitters arranged in three groups, to which I referred a month ago, and so arranged to give an alternative local programme in almost every part of the country, with a third programme available to the users of more sensitive sets. Rome 1, Bologna, Bari 1, Palermo and Naples 2 form one group, with Rome 2, Milan 1, Trieste, Genoa 1, Bolgano, Turin 1, and Florence as an alternative. The third programme is radiated by Florence 1, Naples 1, Milan 2, Rome 3, Bari 2, Genoa 2, and Turin 2.

It is proposed to install a new transmitter in Romania at Kishinev, near the Ukrainian border. This will have an output rating of 20 kilowatts, and it will operate on 201.1 metres. The new station is to be called Radio-Besserabia, and its *raison d'être* appears to be largely for propaganda purposes. It should be heard in this country, for there is nothing sharing the wavelength with an output power greater than 0.7 kilowatt.

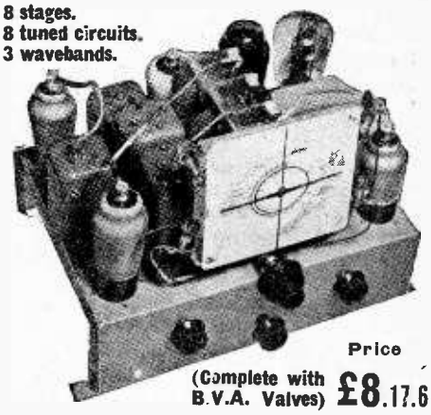
I wonder who will be the first person to receive India on the medium waves? The Lahore station is now nearly complete, and if all goes well it should be at work within the next week or two. At least five other medium-wave stations in India will open up between now and this time next year.

D. EXER.

McCARTHY

6-valve all-wave Superhet with Radio Frequency Stage

8 stages.
8 tuned circuits.
3 wavebands.



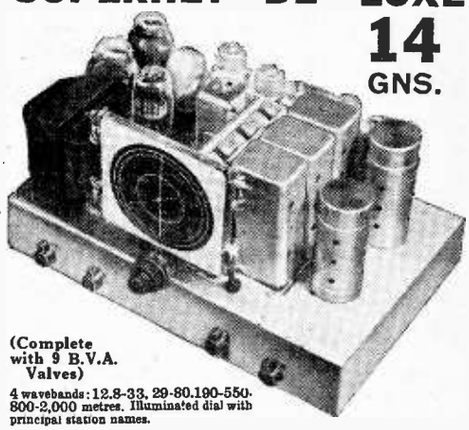
Price (Complete with B.V.A. Valves) £8.17.6

Performance (made possible by use of multi-electrode valves) equal to that of many receivers employing 8 valves or more. Brief specification includes: Large "Airplane" dial, with different coloured lights automatically switched on for each wave-range. Micro-vernier 2-speed drive. 4-point wave-change and gramophone switch. Volume control and variable tone control also operative on gramophone. Reinforced heavy-gauge steel chassis. Covers 19–2,000 metres.

Circuit comprises: Preselector circuit, radio frequency amplifier (operative on all 3 wavebands), triode-hexode frequency changer, double band-pass I.F.T. coupled I.F. amplifier, double diode-triode detector and L.F. amplifier. D.A.V.C. applied to 3 preceding valves. 3-watt pentode output.

9 VALVE FOUR-WAVE SUPERHET DE LUXE

14 GNS.



(Complete with 9 B.V.A. Valves)

4 wavebands: 12.8–33, 29–80, 190–550, 800–2,000 metres. Illuminated dial with principal station names.

Controls.—A feature of the receiver is the number of independent controls fitted, making it extremely interesting to operate. These include sensitivity control (varying bias on R/F stage), or Q.A.V.C. with manual muting control for inter-station noise suppression. 5 position wave-change and gramophone switch. Progressive variable tone control operative on radio and gram.

Circuit in Brief.—Aerial input to pre-selector circuit, radio frequency amplifier, latest type triode-hexode frequency changer, 2 band-pass I.F.T. coupled I.F. amplifiers, double diode detector, triode L.F. amplifier, separate triode phase-changer capacity coupled to 2 large pentodes in push-pull. Heavy 16-gauge steel chassis. Finest components and workmanship throughout. Harries tetrodes in place of output pentodes if desired.

STANDARD MODEL 12 GNS. As above, but with triode push-pull output, and fewer controls fitted

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Demonstrations Daily

All McCarthy receivers supplied complete with valves, knobs, pilot lamp, leads, mains cable and plug, 12 months' guarantee. (Valves 3 months.)

Complete illustrated catalogue, with technical data and circuit diagrams, on receipt of 3d. in stamps, or abridged list of McCarthy chassis types free of charge.

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*Telephone: Bayswater 3201*2

BROADCAST BREVITIES

NEWS FROM PORTLAND PLACE

Empire v. Television

THE B.B.C. is now on tenterhooks regarding the rumoured Treasury share-out for world broadcasting and television. How much money, if any, will each get?

The problems of television are known to us all, but what about the future of the Daventry service?

Oxford Accents from Berlin

SIGNS and portents of an international ether war are not wanting. Hitherto most radio collisions between nations have been on the wavelength question, but a larger and more formidable contest looms ahead.

Already in America it is noted that German stations are using announcers with "impeccable Oxford accents" for their transmissions in English.

Misleading

Moreover, it is pointed out, as one instance of direct rivalry, that the 6.40 p.m. news from Daventry on 11.5 megacycles is followed by an English bulletin from Berlin at 7.15 p.m. on 11.7 megacycles, a small enough separation to mislead distant listeners into thinking that they are picking up the British station.

To avoid misunderstanding, the world transmissions from Daventry will be punctuated with frequent announcements of identity. Indeed, it is rumoured that Daventry's new motto will be "No connection with the firm next door."

Sorting Out the Stations

The Arabic programmes from Daventry, which will probably be the first of the foreign transmissions, will start in February. They will be in more or less direct competition with the Arabic transmissions of Germany and Italy.

Soon the ether will be so filled with information of one kind and another that it will be as difficult to sort out the facts, let alone distinguish which station is which.

Gramophone Broadcasts

IT may be all wrong to suggest that gramophone transmissions are often better than "live" studio material, but many people hold the view, not without reason.

In the first place, gramophone entertainment is always flawlessly presented, owing to the number of recordings made until a perfect disc is achieved. Secondly, the broadcast transmission of gramophone records has reached such a high standard that the quality is often better than that obtained from a record played on the home radiogram.

Not "Fill-ups"

Bearing this in mind, John Watt, B.B.C. Variety Director, has decided to plan regular gramophone programmes, trying them out first on the afternoon audiences. If the experiment is a success they may find a niche in the evening transmissions. "We want to get rid of the idea," says Leslie Perowne, handling the programmes, "that gramophone records are used merely as fill-ups. We are going to give them more 'production' by means of scripts, compères, and so on." Believe it or not, people do still actually write to the B.B.C. "thanking the announcer who chose the nice records I heard at lunch to-day"!

Ringing the Changes on Bow Bells

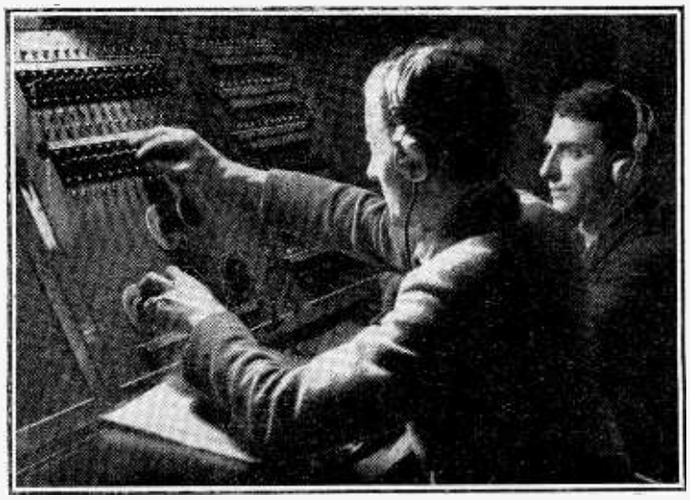
Incidentally, few discs are played more than twice. The slightest sign of wear means their banishment, for the collection of records intended for distribution to the various stations at short notice must be perfect.

The Bow Bells record used for the interval signal is changed twice or three times a week.

Super-Emitron Again

AS the internal control racks at Alexandra Palace are not yet adapted to the new Super-Emitron camera, first exclusively described in *The Wireless World* of November 18th, the mobile scanning van had to be used to feed the transmitter when the camera was first employed for an indoor event. This was at the Alexandra Palace Amateur Boxing Tournament last week, when it was used to great advantage.

Philip Dorté, the producer, who sat at the control desk in the van, is one of the early "hams." His call sign was 2XM. It was Dorté who controlled the television transmission from the Cenotaph.



PRAISE WHERE PRAISE IS DUE. Producers, artistes, conductors, etc., are all féted for their work in the programmes, but on the men in the control room falls the big responsibility of listening to every programme and when the announcer says, "We are now taking you over to . . . . . " the switch goes over and the next part of the programme is faded in.

New Relay Compaign

"STOPPING up the holes" is now the policy of the B.B.C. Engineering Department. To explain: It is realised that the country still bristles with blind spots which the present chain of Regional stations cannot penetrate. Therefore a minor network of 5 kW relay stations is being planned.

Any More Blind Spots ?

The first will probably be at Nigg, near Aberdeen. An East Anglian relay may be expected before the end of 1939. Two will be erected along the south coast. Mid-Wales is also indicated.

Can anyone think of other areas which need a little signal boosting?

Demolition

IN Portland Place every day is moving day. Gradually all the B.B.C. staff now working in the doomed buildings adjoining Broadcasting House are being transferred to the old Scott's Hotel.

By the end of the year demolition will begin in Portland Place.

Those Dormitories

Some of the staff now being recruited for the polyglot service from Daventry may need night accommodation.

Stenographers dealing with the Spanish and Portuguese transmissions will work from 9.0 p.m. to 2.0 a.m. Dormitory accommodation will be provided on an even more lavish scale than for the Empire announcers who now have camp beds which are the last word in camping luxury.

Stenographers who can cope with Arabic will have more reasonable hours, viz: from 2.0 to 7.0 p.m.

Daventry Getting Ready

In one respect the B.B.C. is ready for the extra work which foreign language broadcasts will throw upon it; that is, the site at Daventry is already large enough to accommodate the extra transmitters which are projected.

Originally the ground owned by the Corporation covered a mere fifty-eight acres; but last year further ninety-five acres were purchased, partly for the new Empire transmitters and partly for contingencies, the chief of the latter being provision for foreign language broadcasts, the need for which was even then coming to be realised.

Trade Propaganda

During the publicity given some months ago to the Corporation's preparations in the event of war, an ingenious inventor of facts stated in print that concrete gun emplacements were being constructed at Daventry. Now it turns out that the concrete emplacements were only the foundations for the aerial masts which are required for broadcasts in foreign languages.

Start Point Station

IN our issue of November 25th we referred to Mr. W. Harding Thompson as the architect for the new B.B.C. station at Start Point.

Mr. Thompson has kindly pointed out to us that this information is incorrect, as the architect is Mr. Leonard Guthrie, who has also designed other stations for the B.B.C.

New Apparatus Reviewed

Recent Products of the Manufacturers

TORTOISE LAMP-LITA

THIS unit, which contains a small step-down transformer, is intended to be used for lighting flashlight-type lamps from the AC mains.

The secondary winding is designed to give 3.5 volts, but a tapping is provided so that 2.5 volts can be taken if required. From either output the maximum current is 5 amps. It is thus possible to light as many as 80 lamps of the 0.06 amp. variety, or 20 of the 0.25 amp. type.

Such lamps are used extensively for illuminating model stages, toy forts, dolls houses and Christmas trees, as well as for a host of other purposes, decorative and otherwise.

From measurements made with this unit, it appears that the secondary winding is connected as shown in the sketch, so that it is possible to obtain an alternative supply of one volt only should it be needed. The connections for this purpose are shown by dotted lines.

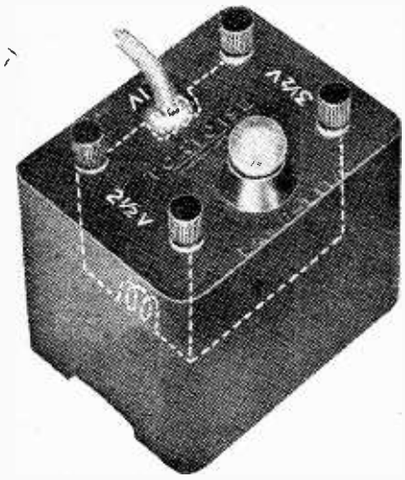
The voltage regulation is as good as can be expected with a transformer of this size, and as expected, the voltage falls to some extent with comparatively heavy loads. From the 3.5-volt winding, for example, the output was 2.8 volts at 4 amps., while with the same load, 1.95 volts were obtained from the 2.5-volt tapping.

The lower voltages are of little consequence as adequate illumination for the purposes mentioned will always be obtained.

The important point is that one lamp only can be lit from the transformer without risk of burning it out as the output voltages do not under any conditions exceed the marked values.

The transformer is housed in a neat bakelite case which completely insulates it, so that it is perfectly safe to handle. A fuse in the form of a small lamp is included in the primary circuit.

The price is 15s. 6d. and it is obtainable from Makers Agents, Ltd., High Holborn House, High Holborn, London, W.C.1.



Tortoise lighting transformer for illuminating Christmas decorations, etc. The secondary winding is connected to the output terminals as shown by the dotted lines.

CLIX ACORN VALVEHOLDERS

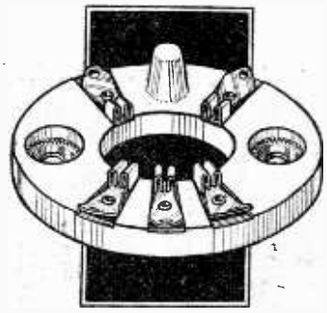
FOR the new Clix holders designed to take the Acorn type of valve a Frequentite disc plate 2in. in diameter is employed. The body of the valve passes through the centre hole and the valve pins clip into miniature knife-edge contacts suitably disposed round the ring.

The American and English Acorn valves are not interchangeable, as in the former the spacing of the anode and grid pins in the triode, for example, is 60 degrees, whereas in the English model a 90-degree angle is used. Clix make holders for both types.

Metal inserts as used on other Clix valveholders having Frequentite plates are fitted into the fixing holes, so that the holder can either be riveted to the chassis or secured by screws without any likelihood of fracturing the plate.

The contacts, which are made of nickel-silver, provide a secure fixing for the valve and at the same time make perfectly sound electrical connections, a very important matter on the ultra-high frequencies.

The makers are British Mechanical Productions, Ltd., 79a, Rochester Row, London, S.W.1, and the price is 2s. for either the English or the American type.



Acorn valveholder with Frequentite base made by Clix.

SECOND-HAND SETS

A NEW enterprise has been started in Newcastle under the name of Reconditioned Radio, Ltd., of 71, Blackett Street. The objects of the concern are to acquire "part-exchange" sets from wireless dealers and to recondition them for resale with a three-months' guarantee. The firm has a shop where reconditioned sets will be on sale.

THE RADIO INDUSTRY

A PA installation that presented several points of unusual difficulty has recently been successfully carried out by Grampian Reproducers, Ltd., at the Saltdean Open Air Swimming Pool, near Brighton. The pool is situated in a hollow in which there is an appreciable natural echo; the Grampian "Jekta" speakers, which radiate a wave with an inverted front, were found to be especially suitable for these conditions.

A new series of Decade Resistance Boxes (Type TF 378) for use with audio or low-radio frequencies is described in a leaflet just issued by Marconi-Ekco Instruments, Ltd., Electra House, Victoria Embankment, London, W.C.2.

Twenty Marconi speakers and a 100-watt amplifier were used by the Marconiphone Company for the PA installation at the Empress Stadium, Earls Court, during a special charity performance of the "Ice Review."

IF..

IF all condensers were scientifically correct in their design and construction . . . if all condensers were known to give unquestioned reliability under every working condition there would be no object in discriminating buying.

Condensers, like eggs, may look the same but they can be very different INSIDE—very different in what has gone into their manufacture, in respect of both experience and materials. That's why the veterans of radio say "T.C.C." every time.

"T.C.C." means 30 years specialised research — 30 years of probing, of experimenting, of *anticipating* the needs of tomorrow — and the day after. That is why when there's a good job of work to be done —when RELIABILITY with "up-to-specification" characteristics are essential, the knowledgeable say—

T.C.C.
ALL-BRITISH
CONDENSERS

THE TELEGRAPH CONDENSER CO. LTD., WALES FARM ROAD N. ACTON, W.2

CA 3540

Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

Scale Distortion

IT is clear to me from "Cathode Ray's" most recent letter that neither "Quality Enthusiast" nor myself has yet been successful in explaining which part of the article entitled "Scale Distortion" we find unacceptable. For my own part I must point out that my original letter, from which the discussion arose, was not intended to question in any way the *existence* of the scale distortion phenomenon, nor did it incidentally contain a naïve claim to the possession of a one or two kilowatt amplifier; despite what "Cathode Ray" still apparently thinks.

Actually, I was using the gross idea of a symphony orchestra playing with all its might in the home listening room, as an illustration of my point, that whilst in strict theory this might nearly constitute "original sound intensity" and so fulfil "Cathode Ray's" condition which he says is necessary to "faithful reproduction"; it is in application of the example taken, almost unthinkable and never obtainable when listening to an actual performance.

In his reply to my letter, "Cathode Ray" demonstrates that he would never in practice make the mistake of acting on this false deduction drawn from the spectrum distortion phenomenon because he objects to my imaginary enormous volume on the solid grounds that the hundred years departed composer could have had no such sound impression in mind; he does himself an injustice in supposing that readers including myself think that he cannot discriminate between sound power and sound intensity, for actually I was merely pointing out a misleading statement which I thought constituted the "real catch" in an otherwise very helpful discussion of the subject.

"Cathode Ray" will indeed compensate very amply for any slight "defocusing" which has occurred if he is enabled to carry out his proposal of investigating the actual differences between sound intensities in large buildings (i.e. actual performances) and those in the home due to reproduction, as no similar data seem to be available as far as I am aware.

J. L. MONTAGUE,
Middlesbrough.

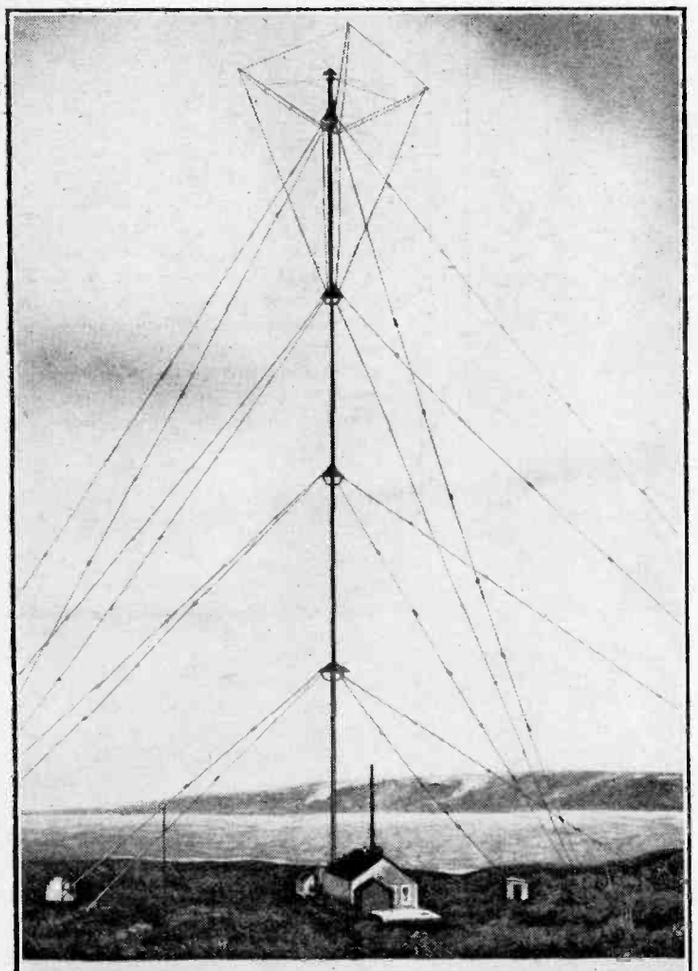


FIG. 6.—Steel Tower, 415 feet high, at Machrihanish, in Argyllshire, used by the National Electric Signalling Co. for wireless communication with a similar station at Brant Rock, near Boston. Professor Fessenden's Wireless Telephony experiments have been mainly carried on between the latter and others in America.

An Early Vertical Radiator

IT is interesting to notice how radio practice seems to revolve.

I have just been comparing the illustration of Stagshaw aerial in the October 22nd *Wireless World*, which represents the most modern practice, with a photograph of the Fessenden aerial at Machrihanish, Scotland, put up in 1905, and described in Erskine-Murray's book on *Wireless Telegraphy* (1909). This aerial was also an insulated mast, 415ft. high, and was provided with a capacity network at the top in much the same way as modern Stagshaw. Its object was, however, quite different, namely, transatlantic communication with the then high power of about 25 kW., in which it was successful.

L. E. NEWNHAM.
Southsea.

Droitwich Quality

I APOLOGISE sincerely for not replying to your further correspondents on the above topic. However, I still beg to insist that Droitwich Quality as relayed from London maintains a top response that is indistinguishable by the ear from that of Midland Regional. I regret that I can offer no scientific proof of this, and it would perhaps appear rather obstinate to press the point in view of the B.B.C.'s admission as to the modification of the response by land lines, and especially the weighty views of *Wireless World* readers, for whom I have the utmost respect. It is not quite clear from Mr. Cluff's letter whether "the land lines" referred to are the lines from London to Droitwich, or the normal O.B. variety. I hasten to add that I have no sympathy with the latter, as the average O.B. is pure rubbish as far as quality is concerned, somewhat akin to the B.B.C.'s efforts at gramo reproduction. There is no comparison between these and the line from London to Droitwich.

The last paragraph of Mr. Winder's letter is very important. He points out that there is a 9 k/cs whistle adhering to the National transmission. I wish to affirm that this is definitely so, and on a high quality receiver it is very prominent. Can the readers who criticise Droitwich hear this? If not, their criticism is valueless.

Again, it would perhaps be of interest to mention that when I used even a broadly tuned RF stage the top cutting on long waves was evident. I regret I cannot do more than say with all truth that I simply cannot hear any difference between the two programmes. This also applies to a friend of mine, another enthusiast whose opinion I asked on the subject.

I note with interest that two of the replies are from Voigt fans, and am gratified to see that Mr. Cluff remembers my earlier letter. He can rest assured that I give and take this correspondence in the true radio amateur spirit.

RC v. Transformer Coupling in Push-Pull Amplifiers

I would like to take this opportunity of supporting "Nauticus" in his views on transformer coupling. It is my opinion and experience that a good loaded transformer is considerably superior to RC, at any rate immediately prior to the output stage. Voltage peaks appear to be handled more faithfully, and transients are not audibly affected.

It goes without saying, of course, that such a component must be very carefully designed in conjunction with its associated valves for the position it is to occupy in the amplifier.

A. A. COTTERELL, LL.B.
Walsall.

"Video" Frequency

CONGRATULATIONS on your "New Readers'" number. My only criticism is that reference was made to "vision frequency." Why not "video frequency"? "Sound frequency" is never mentioned; it is always "audio frequency." I have heard it said that "video" is grammatically incorrect, but if it is, so is the very word "radio." "Video" corresponds

exactly to "audio," and is also a less ugly word. Radio is a new art, and everything else has been named rationally, so let us not be inconsistent over a small matter like video frequency.

Bishop's Stortford. J. A. STANIER.

The Wireless World Diary, 1938

ONE of the most useful and yet inexpensive Christmas gifts is undoubtedly a diary. Even those people who never bother about keeping up daily entries are glad to have somewhere to enter up notes of appointments and similar matter. In the case of the wireless experimenter it is possible for him to have a diary which contains a wealth of handy technical data and other information concerning wireless which will be invaluable to him, no matter whether wireless be his profession or hobby. Such a volume is the 1938 Wireless World Diary which, apart from much technical information, contains a comprehensive list of the principal European broadcasting stations, together with their frequency, wavelength and power.

Complete information is also given concerning the various amateur wavebands. Included, in addition, are the Morse Code and the various abbreviations used by amateur and professional transmitting stations. Other features include circuit diagrams of modern sets and amplifiers, and abacs for quickly ascertaining various facts without the labour of lengthy calculations. Standard wire tables and complete data concerning valves are also included. The Diary, which costs 1s. 6d., may be obtained through any newsagent or for 1s. 7d., post free, direct from the publishers, Messrs. Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

Club News

Kingston and District Amateur Radio Society

Headquarters: Three Fishes Hotel, Richmond Road, Kingston.
Hon. Sec.: Mr. D. N. Biggs, 44, Pooley Green Road, Egham, Surrey.

The talk given by Mr. Wilkins, of the Automatic Coil Winder and Equipment Co., on Avo test apparatus was a great success. On December 15 there will be a lecture and a demonstration of the "Evrizone" single-signal superheterodyne. Commencing in January there will be two meetings each month, as well as three group meetings. The group meetings will be held at members' private addresses. Details are obtainable from the hon. sec.

Southall Radio Society

Headquarters: Southall Library, Osterley Park Road, Southall.
Meetings: Tuesdays at 8.15 p.m.
Hon. Sec.: Mr. H. F. Reeve, 26, Green Drive, Southall.

Recently Mr. W. G. Pyke lectured on "The Practical Side of 56 Mc/s." Several members of the Thames Valley Society attended this meeting. At the talk given by Mr. W. Nixon, of the Osram Valve Technical Department, films were shown of the various manufacturing processes. The 1938 session commences on January 11th. There will be no meetings on December 28th and January 4th.

The Smethwick Wireless Society

Headquarters: New Talbot Inn, High Street, Smethwick.
Meetings: Fridays at 8.30 p.m.
Hon. Sec.: Mr. E. Fisher, 33, Freeth Street, Oldbury.

Great appreciation was expressed by members at the result of their recent visit to the Droitwich station, the success of the visit being chiefly due to the explanations of Mr. Baker, who conducted the party round the station. The society is at present engaged in experimental transmission and reception work on the 5-metre band.

Wirral Amateur Transmitting and Short-wave Club

Headquarters: Beecheroft Settlement, Whetstone Lane, Birkenhead.
Meetings: Second and last Wednesday evening in each month at 7.30 p.m.
Hon. Sec.: Mr. J. R. Williamson, 49, Neville Road, Bromborough, Birkenhead.

The theme of the talk given recently by Mr. N. C. Hobbs was the method by which signals reached the other side of the globe. The club receiving contest will be held shortly and arrangements are well in hand.

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

Many interesting discussions took place at the recent Questions Night held by the above society. The subjects dealt with included loud speaker, sound film equipment, studio echo, pick-up design, heterodyne whistle filters and the avoidance of room resonance.

Bradford Radio Society

Headquarters: Cambridge House, 66, Little Horton Lane, Bradford.
Meetings: Tuesdays at 8 p.m.
Hon Sec.: Mr. S. Hartley, 7, Blakehill Avenue, Fagley, Bradford.

On December 14th Mr. J. E. Preston, of the Whiteley Electrical Radio Co., Ltd., will give a lecture and a demonstration of the Planoflex loud speaker. A special invitation has been issued to the Bradford Short Wave Club to attend this lecture.

Dollis Hill Radio Communication Society

Headquarters: Braintcroft Schools, Warren Road, London, N.W.2.
Meetings: Alternate Tuesdays at 8 p.m.
Hon. Sec.: Mr. J. R. Hodgkyns, 102, Crest Road, Cricklewood, N.W.2.

A talk on 10-metre transmission and reception will be given by Mr. H. Wilkins on December 14th. On December 21st there will be a lecture on Simple Mathematics and Ohm's Law.

Kettering Radio and Physical Society

Headquarters: The Ivy Café, Gold Street, Kettering.
Meetings: Mondays at 7.30 p.m. Short-wave section and Morse Class, Tuesday evenings at 7.30 p.m.
Hon Sec.: Mr. J. L. Holmes, "Miami," The Close, Headlands, Kettering.

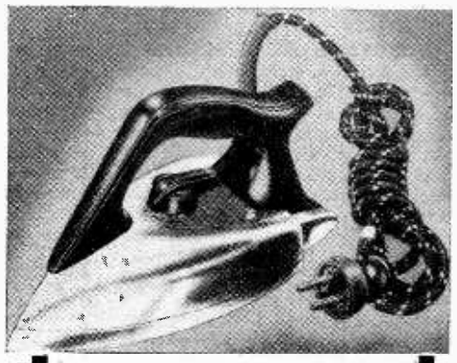
Mr. F. K. Webb, of Pye Radio, Ltd., recently gave a lecture on "The Problems of Short-wave Reception."

West Sussex Short-wave and Television Club

Headquarters: The Waggon and Lamp, Chichester.
Meetings: Thursdays at 8 p.m.
Hon. Sec.: Leading Aircraftman J. Williams, H.Q., Flight 43 (F) Sqdn., R.A.F., Tangmere, Sussex.

A lecture and demonstration on cathode ray tubes and associated apparatus which was spread over two evenings was recently given by Mr. A. F. Hollins, of the Mullard Wireless Service Co. The club was presented with a cathode ray tube at the close of the first part of the lecture.

ROLAMATIC



A PRESENT OF PERMANENT UTILITY

There is no need to wonder why we are advertising Electric Irons in a man's paper because we are going to let you into the secret right away. This is Rola's contribution towards the solution of your Christmas present problem. Wouldn't *you* be delighted if someone gave you a Rola speaker? Well, then, why not give the wife a similar treat? She might not appreciate a loud speaker but you can be absolutely certain that she'll be delighted with a Rolamatic Electric Iron. A Rolamatic is never too hot and never too cold. Its heat control marked in terms of fabrics from artificial silks to linens, eliminates the hazards of scorching. It is perfectly balanced, gracefully streamlined and handsomely finished in untarnishable chromium plating. There is no enamel to chip or crack. We could tell you a whole lot more but we've run out of space so will you please write for folder "RA" or ask your nearest high grade Electrical Dealer, Department Store or Supply Corporation to show you a Rolamatic Electric Iron. Incidentally, your shirts will benefit by the change because a Rolamatic definitely ensures better ironing!

5/- for Your Old Electric Iron

If you can lay hands on your wife's old electric iron whatever its age or condition, any Rola dealer will give you 5/- allowance in part exchange for a brand new Rolamatic. Why not see what you can do about it?

THE BRITISH ROLA CO., LTD.
MINERVA ROAD, PARK ROYAL, N.W.10.
PHONE: WILLESDEN 4322-3-4-5-6.

Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section

ELECTRON MULTIPLIERS

RELATES to electron multipliers of the kind in which a stream of electrons is made to impact, in succession, upon a series of target electrodes, the result of each impact being to produce secondary electrons which go to swell the original stream.

According to the invention, the ordinary flat type of target electrode is replaced by one which closely resembles the "gun" of a cathode-ray tube; that is to say, it consists of a cup or pocket containing an electron-emitting material. The cup lies close behind an apertured disc through which the electrons first pass, before they come under the control of a second apertured disc, which serves as an accelerating electrode.

The series of "guns" are equally spaced apart, and are biased with progressively-increasing voltages, so that the main stream passes from one gun-target to another, in a series of semicircular steps, towards a final output electrode.

Marconi's Wireless Telegraph Co., Ltd. and G. F. Brett. Application date February 8th, 1936. No. 470026.

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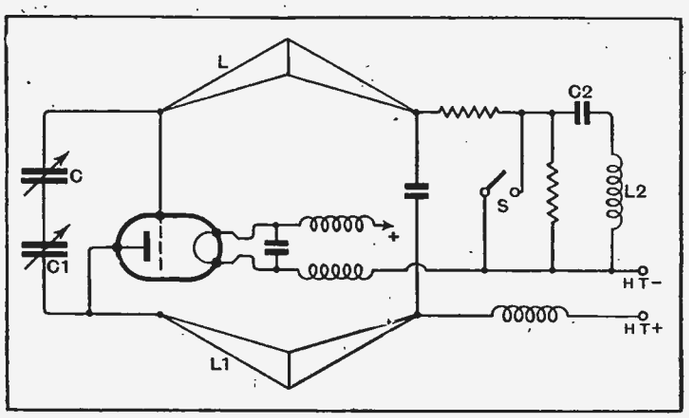
PORTABLE TRANSMITTER AND RECEIVER

THE figure shows the circuit of a single-valve short-wave portable set suitable for combined transmission and reception.



Circuit of trans-receiver designed to operate at a constant frequency with high or low HT voltages.

Usually the anode voltage on the valve is increased for transmission and reduced for reception; but when a single aerial is used for both purposes, this has been found to alter the frequency of the tuned circuits.

According to the invention, the difficulty is overcome by introducing a series resonant circuit across the grid and filament of the valve as the anode voltage is reduced. For instance, when used as a transmitter the frequency of the outgoing waves is determined by the inductance of the leads L, L1 and the condensers C, C1. For reception a switch (not shown) reduces the anode voltage, and simultaneously another switch S is opened to bring a condenser C2 and inductance L2 into the grid circuit. This is stated to eliminate the Miller effect, and keep the frequency of the valve constant both during reception and transmission.

E. K. Cole, Ltd. and E. Garthwaite. No. 470366.

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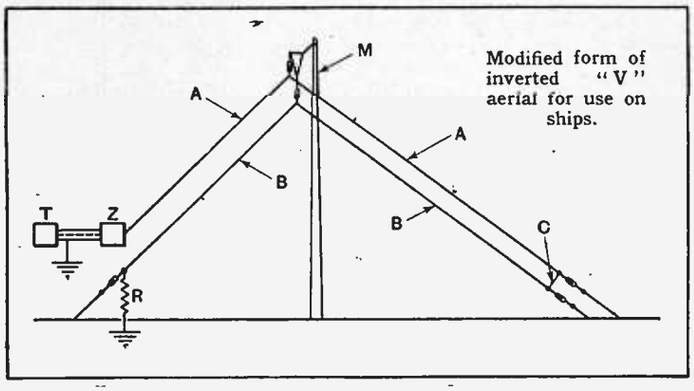
SHIPS' AERIALS

WHEN a ship is detailed to travel more or less constantly on a to-and-fro voyage along the Great Circle between two given ports, it is an advantage to use an aerial with bi-directional rather than uni-directional properties, so that signals may be sent with equal facility to either of the two terminal ports. For this kind of work an open-ended aerial seems to be more suitable than one terminated by an impedance, since the latter would normally require to be separately adjusted for each change of the working wavelength.

This objection is removed by using an aerial of the kind shown in the Figure. It consists of two parallel wires A, B, which are bridged together by a link C at the far end. One wire B is terminated at the near end by a surge impedance R, to prevent reflection whilst the other wire A is connected through an aperiodic coupling Z to a transmission or feed line T. The arrangement gives a substantially constant end impedance at Z over a wide range of signalling frequencies. Instead of using the inverted-V arrangement shown, the bridge-piece C may be inserted across the two wires at the top of the mast M.



Modified form of inverted "V" aerial for use on ships.

Standard Telephones and Cables, Ltd. (assignees of A. Alford). Convention date (U.S.A.) March 17th, 1936. No. 469589.

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DIRECTION-FINDERS

ONE known arrangement for giving a direct reading of the bearings of a distant transmitter is to combine the pick-up from a rotating system of frame aerials with the pick-up from a vertical or non-directional aerial.

According to the invention, instead of rotating the frame aerials, they are held fixed, but the pick-up voltages are periodically reversed by an electrical "switching" arrangement. This comprises a pair of rectifiers shunted across the two aerial coils and energised alternatively from a local source of low-frequency current.

The effect is the same as if the frames were constantly rotated. The resulting currents are combined with that from a single vertical aerial, and are then fed to a direct-reading indicator.

Soc. Français Radio-Electrique. Convention date (France) December 30th, 1935. No. 470060.

o o o o

SCANNING SYSTEMS

WHEN a rotating drum or disc is used to scan a picture, a certain amount of distortion is introduced owing to the original rectilinear outline of the picture being transformed into a trapezium or wedge-shaped area.

According to the invention, this is corrected by causing the aperture to undergo a real or apparent displacement during the process of scanning. For instance, a number of slots on a rotating disc are made to intersect with a fixed slot in a masking-device, so that the area formed by the intersection constitutes the actual scanning aperture. By a suitable relative inclination of the fixed and moving slots the correction required to avoid trapezium distortion can be readily applied.

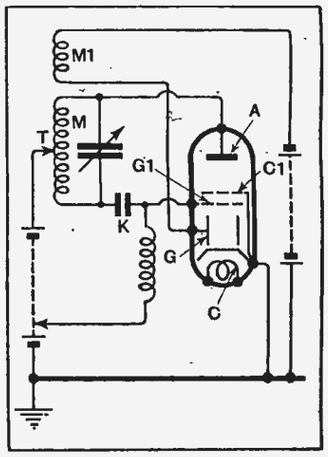
Baird Television, Ltd. and J. L. Baird. Application date June 30th, 1936. No. 469673.

o o o o

"BEAM" VALVES

RELATES to the use of reaction in an "electron beam" valve, where the electrons are formed into a jet or beam more akin to that which passes through a cathode-ray tube than to the ordinary discharge through a thermionic valve.

As shown in the drawing, the beam valve consists of a cathode



Improved beam-type valve in which provision is made for controllable reaction.

C (which is directly connected to a "guard" electrode C1 to reduce secondary emission), a control grid G in the form of a Wehnelt cylinder, and an accelerating electrode G1. A tuned oscillatory circuit M is connected across the output anode A and the accelerating electrode G1, *via* a blocking condenser K, and an intermediate tapping T on the circuit M is taken back through the HT supply to the cathode.

Reaction is applied through a coupling coil M1, one end of which is connected to the control grid G, and the other end, through a negative bias, to the cathode. The arrangement gives a smooth control of reaction such as is necessary when the type of valve in question is applied to wireless reception.

Marconi's Wireless Telegraph Co., Ltd. and G. M. Wright. Application date February 8th, 1936. No. 470025.

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from Specifications Obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each. A selection of patents issued in U.S.A. is also included.

The Wireless World
THE PRACTICAL RADIO JOURNAL
27th Year of Publication

No. 955. THURSDAY, DECEMBER 16TH, 1937. VOL. XLI. No. 25.

Proprietors : ILIFFE & SONS LTD.

Editor :
HUGH S. POCOCK.

Editorial,
Advertising and Publishing Offices :
DORSET HOUSE, STAMFORD STREET,
LONDON, S.E.1.

Telephone: Waterloo 3333 (50 lines).
Telegrams: "Ethaworld, Sedist, London."

COVENTRY : Hertford Street.
Telegrams: "Autocar, Coventry." Telephone: 5210 Coventry.

BIRMINGHAM :
Guildhall Buildings, Navigation Street, 2.
Telegrams: "Autopress, Birmingham." Telephone: 2971 Midland (4 lines).

MANCHESTER : 260, Deansgate, 3.
Telegrams: "Iliffe, Manchester." Telephone: Blackfriars 4112 (4 lines).

GLASGOW : 26B, Renfield Street, C.2.
Telegrams: "Iliffe, Glasgow." Telephone: Central 4857.

PUBLISHED WEEKLY. ENTERED AS SECOND CLASS MATTER AT NEW YORK, N.Y.

Subscription Rates :
Home, £1 1s. 8d. ; Canada, £1 1s. 8d. ; other countries, £1 3s. 10d. per annum.

As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

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EDITORIAL COMMENT

Rediffusion

Awaiting a Statement

WE have already expressed opinions as to the importance of the moves now being made by the Post Office to take over the broadcast relay systems with a view to developing them on a national scale with the aid of the huge resources and organisation which the Post Office commands.

Our contemporary, *The Electrician*, has referred recently to our comments on this subject, and suggests that the electricity supply mains, which reach a much larger number of people than the telephone circuits, would seem to provide a more suitable medium for the distribution, especially in emergency, and it is hinted that the Post Office would probably be able to obtain facilities from electricity supply undertakings for the use of their mains, against payment of a reasonable rental.

We have refreshed our minds with what occurred in 1934 when a demonstration was given in Liverpool to show the possibilities of broadcast relaying over electric mains, which resulted in an attempt to obtain Parliamentary sanction for electricity supply authorities to utilise their mains for distribution to individual houses for this purpose. The opposition to this proposal was considerable and eventually it was dropped, but it is interesting to note that the Postmaster General expressed the opinion then that he was not opposed to the principle.

We believe that the real reason the idea was turned down was that it would have been giving to the electricity supply authorities, who already hold a monopoly under the Government, authority to earn additional revenue from a source not included in their monopoly but made possible by virtue of that monopoly. When a monopoly is granted by the Government it is generally understood that those to whom it is given are restricted in their commercial activities to whatever enterprise is defined by the monopoly.

But quite a new complexion might be given to the question of utilising the electric supply mains for broadcasting if it were the Government itself which decided to utilise them, and it might well be that the Postmaster General could more or less commandeer the electric supply network for this purpose.

We believe that very little time can elapse now before the Postmaster General must make a statement, indicating clearly what is to be his policy in regard to the operation of the relays, and no doubt when that time comes there will be opportunity given for the fullest consideration of the whole question before the country is too far committed.

Things to Come

Our Readers' Choice

THE WIRELESS WORLD Questionnaire, which we invited readers to fill up and send to us some weeks ago, met with such a gratifying response from our readers that it has been a long task sorting out the valuable information which these replies provided.

Some suggestions put forward are being acted upon as a gradual process, and from time to time we shall be announcing "by request" articles which we believe will be of special appeal. The intention is also to discuss design of receivers from a very practical point of view, explaining the reasons for the choice of values and circuits and accompanying these discussions with the practical designs themselves.

B.B.C. Research

By H. L. KIRKE

ACOUSTICS, STUDIO DESIGN AND AUDIO-FREQUENCY INVESTIGATIONS

IN last week's issue the B.B.C.'s chief of research described the work of the section of his department which devotes itself to matters of an essentially radio-frequency nature. He now tells us how acoustic, audio-frequency and kindred problems are investigated.

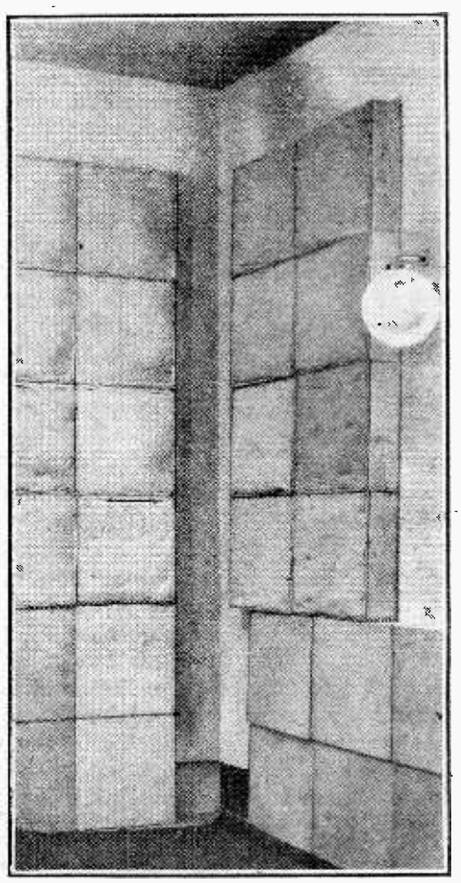
THE work of the Acoustics Section is chiefly concerned with the design of studios. This work can be divided into two main headings, namely, the research work in the laboratories and the application of the results of research work to the actual design.

Laboratory research into acoustics involves not only the actual research work, but the development of methods of measurement, the most important of these being the instrument used for the measurement of reverberation time. The old method was to use a warble tone injected through a loud speaker into a room whose reverberation time it was desired to measure. A microphone in this room picked up the sound, which was interrupted after the sound had been left on for a sufficient time for a steady state to be built up in the room. The time taken for the sound to decay by a certain number of decibels was then measured, and the results interpreted in the form of reverberation time. This method, however, was not entirely satisfactory in that it did not give all the information required, nor were the results sufficiently accurate in some cases. In fact, in certain instances the results were liable to be quite misleading. The present method is similar, except that instead of measuring the time taken for the sound to decay a certain amount, the sound intensity into the microphone is recorded by an instrument known as the Pegelschreiber, which records the amplitude of the sound against time. The reverberation time is then deduced from the slope of the curve, which not only gives information regarding the reverberation time, but information regarding the shape of the curve, which has an important bearing on the acoustics of a room.

Thick Concrete Walls

Measurements on acoustic materials are done mainly in a reverberation chamber in the Research Department. This consists of a concrete shell with walls, floor and ceiling one foot thick. This shell is built inside what was once a chapel, and rests on six inches of cork, the object of this type of construction being sound insulation. When this room was first built considerable difficulties were encountered. These turned out to be due to the fact that the whole structure of the inside shell had a natural frequency of 180 cycles per second and a very low decrement, a sound at that frequency taking over a quarter of a minute to die away. This is not an infrequent fault of a homogeneous concrete structure. It was cured by filling up the space between the outer wall of the shell and the inner wall of the main building with sand and putting a layer of sand about a foot thick above the shell.

We have also two experimental studios, one 23 × 14 × 13 feet high, and the other 11 × 6½ × 10 feet high. These have proved of great value, both in testing out various acoustic materials in the form they would be used in a studio and in ascertaining the effect of the distribution of the acoustic material in the room. The design of studios is based on the results of laboratory research work, and also on practical experience in studios themselves. The results of research work do not always agree with effects in the studios, and as it is not possible to build experimental studios *ad lib.*, a certain amount of intelligent guessing or, as it has been called, "guestimation," has to be indulged in.



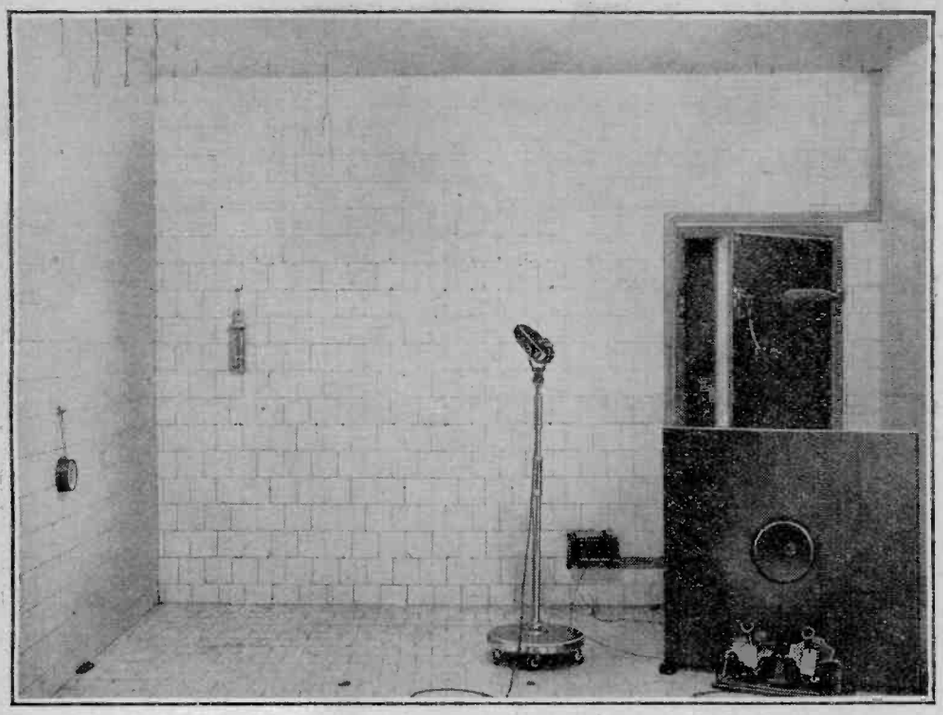
A corner of the experimental studio. Note that the acoustic treatment of the walls can easily be rearranged, as the sound-absorbing material is in boxes.

The general method of procedure in the design of a new studio is for the Research Department to prepare a specification of the acoustical treatment in co-operation with the Civil Engineer's Department, which is responsible for the actual building work; and, as Shakespeare says, "here's the rub," for acoustic requirements seldom fit in happily with building requirements and costs. As in the design of transmitters, it is easy to achieve high quality if cost is no object, so in acoustics it is relatively easy to design a first-class studio if cost is no object. But cost always is an object, and a very important one.

Reverberation Characteristics

One of the difficulties of acoustics is that the overall result is so much a matter of taste. Some people, as listeners, like a "live" and reverberant studio; others like a "dead" studio. But there are certain general rules regarding the requirements of studios for different purposes. For example, in a dance band studio a rather clear-cut, not too reverberant result is required, since the precision of rhythm is of great importance; whereas for general orchestral work a more reverberant and blended effect is preferable. Again, the type of reverberation which is desirable for orchestral work is not necessarily the same as that desirable for singing or speaking. This question arose in connection with Covent Garden, where, in order to obtain a better overall effect, it was found expedient to introduce artificial echo. But here it was found that the type of artificial echo required for the orchestra was different from that required by the singers. This was obtained by the use of one set of microphones for the orchestra, which were situated so that their directional effect made them insensitive to singers, and another set of microphones for the singers. The different artificial echo effects were obtained by the use of two loud speakers in different positions in the echo chamber, the one loud speaker being used for singing in connection with the singing microphones, and the other in connection with the orchestral microphones. In this particular case it was found that the Concert Hall in Broadcasting House made the best echo chamber of all.

When a studio has been designed and constructed, it is then necessary to measure its reverberation time and to carry out tests with orchestras and singers in the case of a music studio, and with



The reverberation chamber, showing loud speakers and microphone. Note the thick, sound-proof door.

speakers in the case of a speech or dramatic studio.

The ribbon or velocity microphone, which is used so extensively in the B.B.C., was designed and developed in the Research Department by the Acoustics Section. When the first models of this microphone had undergone service tests in studios, and had been pronounced satisfactory in performance by all the people who use them, an order was placed with a manufacturer for the supply of microphones for all studio centres.

Open-Air Microphone

The Microphone Section is now engaged in the development of other types of ribbon microphones and modifications to existing types for different purposes. For example, for use in the open air a microphone which will not be affected by gusts of wind is required. Experiments in connection with this are now in hand. A special instrument for carrying out tests on ribbon microphones has recently been designed.

One of the most important activities of this Section is liaison with the Programme and Operating Departments. This has been going on for some years, and provides not only valuable assistance to these Departments, but affords also a knowledge of operating conditions which is essential to any research work of this type. One of the research engineers—he who was responsible for the design of the ribbon microphone—spends about 90 per cent. of his time in and about studios, concert halls and the scenes of outside broadcasts, in liaison with the Programme and Operating Departments.

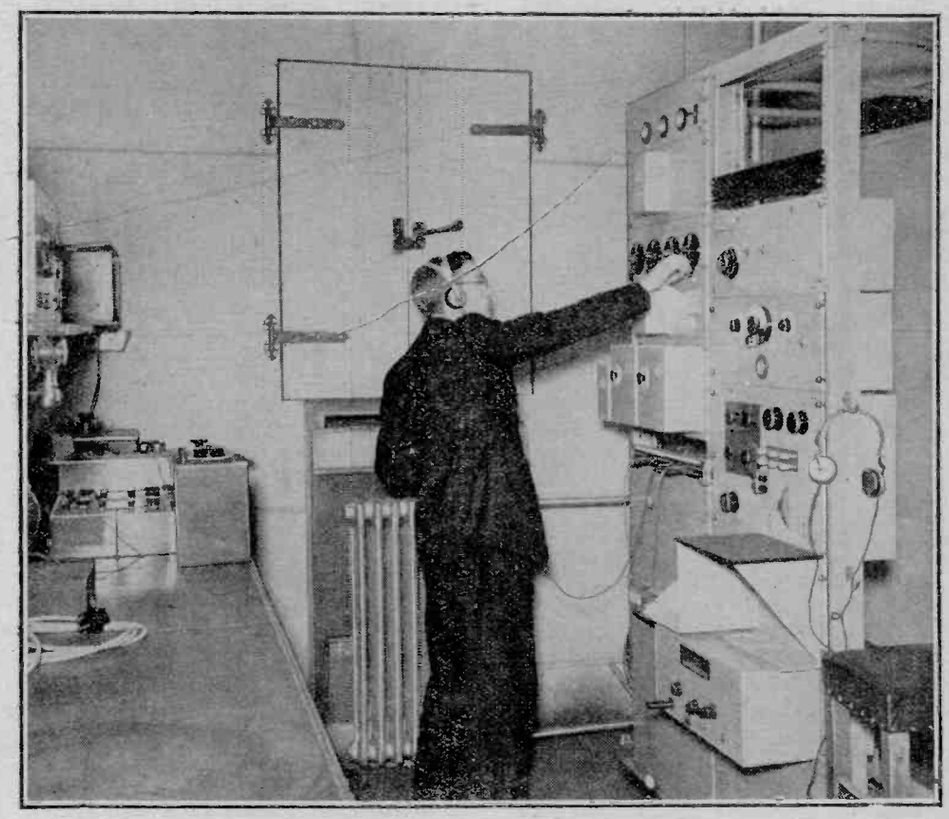
The testing of loud speakers is a function of the Acoustics Section but, as in the case of receivers, we do not attempt the design of loud speakers, but confine our work to comparison and testing of the various makes submitted to us by manufacturers.

In the Audio Frequency and Recording Section, work is done on low-frequency amplifiers and transformers, with the object of keeping up to date and providing data for use by the Designs Section, which is responsible for the design of speech input equipment. Naturally, this includes work on reverse feedback and, in co-operation with the Valve Section circuits have been developed which will very much simplify and improve the design of speech input apparatus, and will probably reduce to a large extent the number of types of valve employed in this equipment.

Modulation Meters

Other work in this Section includes the design of monitoring apparatus such as programme meters, or level indicators. It is very important in broadcasting that the maximum level and maximum percentage modulation shall be used in order to obtain the highest efficiency and greatest signal-to-noise ratio. For this reason it is important to develop satisfactory level indicating apparatus. Such apparatus has undergone great changes in the fifteen years of broadcasting and, as technique improves, so methods of measurement improve.

Work is carried out on various methods of automatic volume control, with the object of reducing the difficulties of manual control, preventing the mistakes which are frequently made in manual control, and increasing the signal-to-noise ratio by keeping up the average level of modulation without spoiling the artistic value of the programme. One instrument for effecting this control has been tested in an experimental form. It consists of a device which reduces the gain of an amplifier when the peak level rises above a predetermined value. The gain returns slowly to normal, provided no further excessive peaks occur. If they do and the



The screened room is used mainly for special measurement work where freedom from both electrical interference and noise is required.

B.B.C. Research—

specified limit is exceeded, the gain is kept down to the reduced value. If peaks occur which are greater than a second and higher limit, the gain is still further reduced.

The tests of this apparatus have shown that it can be used successfully, but that its chief function will be to prevent transmitter and apparatus overloads which would otherwise result in distortion. It will not supersede manual control, or any other form of automatic control; but being much quicker and more reliable in operation than manual control, it will avoid distortion due to human error. The audible effect of the suddenly reduced volume is surprisingly small.

The work of recording is of considerable interest. Our research work includes investigations into Marconi-Stille steel tape recording; cellulose disc recording; Philips-Miller mechanically cut film recording, and, of course, the reproduction on ordinary commercial discs. In all this work we are in active co-operation with manufacturers and with the Technical Recording Section, which is responsible for the actual making of records.

New systems of recording are subjected to tests, either during a visit to the manufacturer's laboratories, or by the manufacturer submitting his apparatus for test in our laboratories. If, as a result of these tests, we think there is sufficient merit in the system to justify its adoption by the B.B.C., we then carry out more extensive tests.

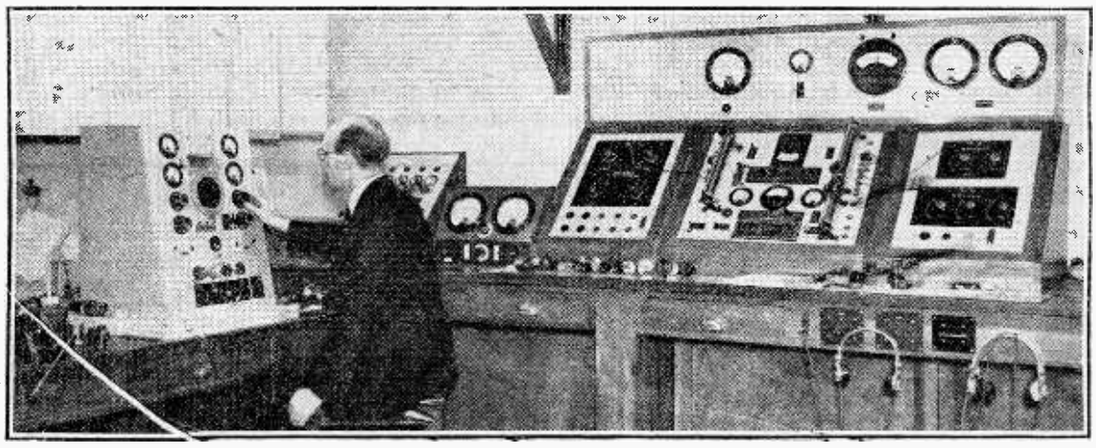
It is seldom that apparatus for recording is submitted for our tests in a form which would be immediately acceptable for B.B.C. requirements. The mechanical design or the overall quality of reproduction may need to be improved, but it is generally possible to say whether the system is capable of being developed. The whole problem is investigated in great detail by the Recording Section in co-operation with the manufacturers, and the apparatus is developed into something approaching a final form. When the performance of the model has reached a sufficiently satisfactory stage, tests and demonstrations are carried out at which members of other departments are present. Needless to say, there is always a great deal of work to be done even when the final models have been delivered, and it may be one or two years from the time when the new system is first introduced to the time when it is finally accepted and put to everyday use by the B.B.C. In the case of disc recording, for example, we are at present engaged in a long research into the best method of storing discs to prevent deterioration. It was found that in a number of cases, discs which had been kept in store deteriorated both in quality and in signal-to-noise ratio. Any experiments of this sort must, of necessity, be a long-drawn-out job.

The Valve Section of the Research Department was started some years ago, mainly with the idea of securing proper liaison with the manufacturers in the design, testing and operation of water-cooled transmitting valves. This work has proved extremely valuable, and has resulted in a considerable increase in the life and reliability of these valves. The Valve Section is now responsible for all the testing of valves at manufacturers' works, and for testing and specifying the operating conditions of valves used at the B.B.C. stations.

The development of small types of valves in co-operation with the valve manufacturers is also undertaken by this Section. Small valves are normally designed for use in commercial radio receivers, but valves designed solely for this purpose are not necessarily suitable for all the uses to which they are put in the broadcasting chain, and the Section has done valuable work in causing the manufacturers to produce special types of valves for our purposes.

In an organisation such as the B.B.C., the number of small valves used is considerable, and the life and reliability of such valves is a very important matter, as the total cost is quite a large item. One of the greatest difficulties with small valves is the production of a high-gain, silent valve for use in the early stages of microphone amplifiers. The Valve Section tests all small valves before they are put into service, specifies the service tests for valves, and designs valve-testing apparatus for use at the stations.

The function of the B.B.C. Research Department in the television field is to keep closely in touch with developments, with the actual service work at Alexandra Palace, and with the manufacturers, in order to give assistance in any direction that may be required. Television at present is in a different state from that of sound broadcasting at the equivalent stage of its growth. It has required far more extensive development before it could be put into practice than did the sound service. The experience gained during the past year at Alexandra Palace will be of great value in shaping future progress.



A new mutual conductance test set is seen in operation in the valve testing laboratory.

News from the Clubs

Kettering Radio and Physical Society

Headquarters: The Ivy Café, Gold Street, Kettering.
Meetings: Mondays at 7.30 p.m. Short-wave section and Morse Class, Tuesday evenings at 7.30 p.m.
Hon. Secretary: Mr. I. L. Holmes, "Miami," The Close, Headlands, Kettering.

Mr. F. G. Glanfield, of Milnes Radio Co., recently gave a talk on the firm's HT unit, in which he described in great detail Mr. Milnes' early experiments with the nickel cadmium type of cell, which eventually led to the development of the HT unit.

Southend and District Radio and Scientific Society

Hon. Sec.: Mr. J. M. S. Watson, 23, Eastwood Boulevard, Westcliff-on-Sea.

Mr. F. S. Adams has been compelled to resign the office of secretary, as he is leaving the district, and Mr. J. M. S. Watson has been appointed in his stead. Another successful field day, which was organised by special request, was held on December 12th.

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

The recent talk and demonstration by Mr. Wilkins on "Avo Instruments and Radio Servicing" was highly appreciated by the members present.

Exeter and District Wireless Society

Headquarters: 3, Dix's Field, Exeter.
Meetings: Mondays at 8 p.m.
Hon. Secretary: Mr. W. J. Ching, 9, Sivell Place, Heavitree, Exeter.

Members recently visited the local power station and took great interest in the system of control. On a subsequent date a lecture on short-wave reception was given by Mr. Cornish, of the General Electric Co., who dealt particularly with the various types of aerial used for SW work.

THE RADIO INDUSTRY

THE British McMurdo Silver Co., Ltd., 20-22, Great Titchfield Street, London, W.1, has prepared a booklet dealing with the design and specification of the "15-17" chassis and its associated acoustic equipment. Those whose task it is to make technical literature readable for the general public might well take this excellently prepared publication as a guide.

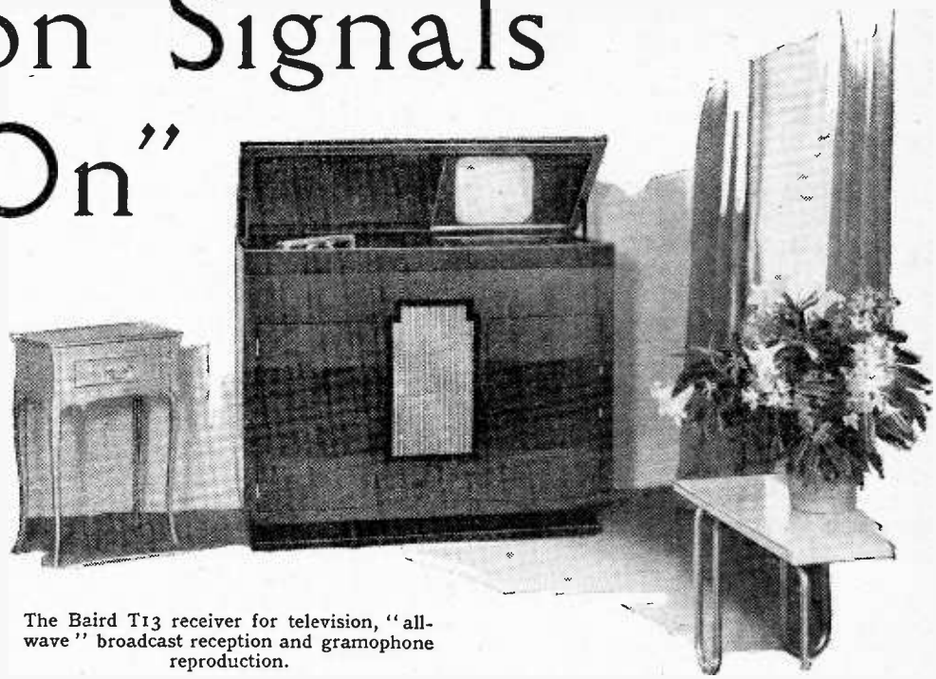
A party of 60 members of the I.E.E. were the guests last week of Steatite and Porcelain Products, Ltd., at the firm's Stourport works, where, in addition to heavy-duty porcelain insulators, die-pressed ceramic insulators for wireless and similar purposes are produced.

The firm of Batwin Electrical Appliances, Ltd., will in future be known as Atlantic Appliances, Ltd.

Television Signals "Laid On"

THE BAIRD AERIAL RELAY SYSTEM

By C. E. MAITLAND, B.Sc.



The Baird T13 receiver for television, "all-wave" broadcast reception and gramophone reproduction.

IT will be generally agreed that conditions of television reception in buildings such as hotels, hospitals, and blocks of flats, where many receivers may be operating within a limited area, call for a centralised system. The radio-frequency distribution system devised by Baird engineers enables occupants to install receivers with the minimum of time and trouble, and to enjoy the programmes under very favourable conditions.

In the system adopted, an aerial erected in a suitable position is connected by line to a central amplifier, which in turn supplies radio-frequency lines running through the building. Junction boxes are spaced along these lines at intervals for feeding the separate flats from the main line via a wall socket, all wiring being run inconspicuously in the manner of ordinary electric power wiring. Each receiver operates exactly as though it were provided with its own aerial, independently of all other receivers in the building.

After research into problems of amplification and efficient transmission of ultra-high-frequency currents and reduction of distortion and electrical interference, a suitable amplifier has been developed. There is no frequency changer in this amplifier, for the signal is sent down the line at its original frequency so that the receivers may be quite standard. It incorporates a number of stages using special wide band-pass circuits, giving an overall characteristic flat to within 2 db. from 43 to 47 megacycles, and without measurable deviation over the sound frequency band.

A mains switch is mounted nearby on the same rack, and as all controls are pre-set, no attention is required during use.

The position of the amplifier in the building is generally as near to the aerial as convenient, and central enough to feed all reception points with the minimum total length of line. It is simpler to deal with short lengths of line for distribution, so the building is usually wired in sections. This also has the advantage of avoiding the extra signal loss to receivers fed from the far end of a single long line. A typical installation might be arranged to feed 100 flats from four lines, each arranged to supply 25 receivers and connected in parallel across the amplifier output.

To feed the receivers from the line, junction boxes are mounted at points where the line passes each flat, and are either joined by a short length of cable to the receiver wall socket, or else are constructed with a built-in socket for direct mounting in the wall of the room. These junctions are attenuation networks of high impedance on the line side, and low impedance on the output side. This is to prevent shunting of the feeder line, and to enable the receiver to be correctly matched.

From the line through the junction to the receiver there is a predetermined amount of attenuation, sufficient to prevent re-radiation back from the receiver into the line. At the same time, the amplified signal down the line is brought

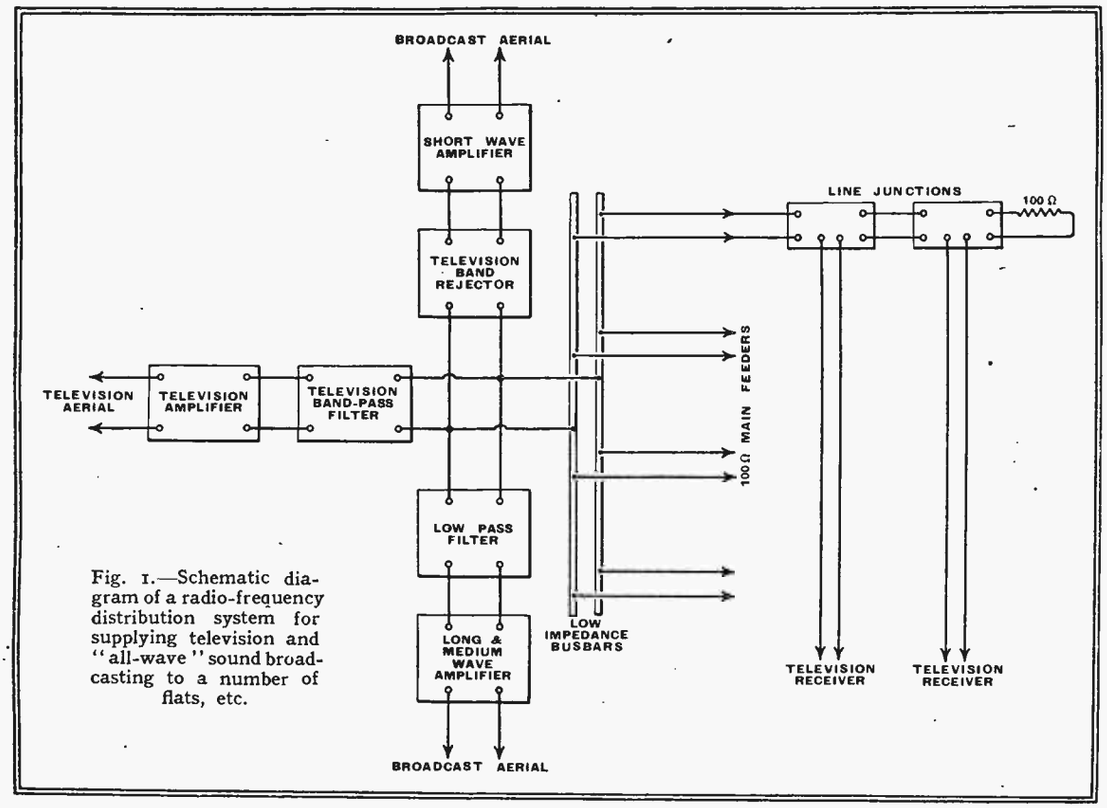


Fig. 1.—Schematic diagram of a radio-frequency distribution system for supplying television and "all-wave" sound broadcasting to a number of flats, etc.

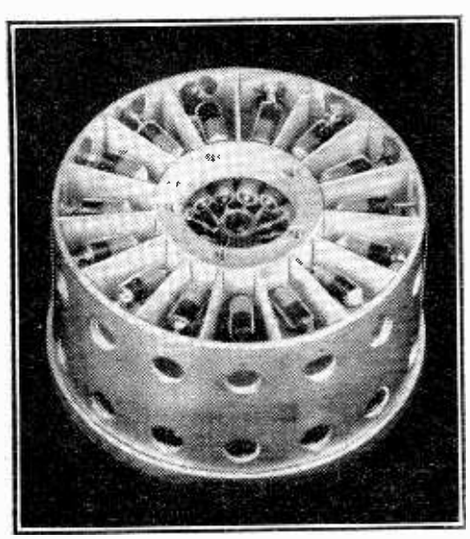
Television Signals "Laid On"—

back approximately to aerial strength again. A schematic diagram of the arrangement is shown in Fig. 1, which also indicates the filtering necessary to allow for the addition of long, medium and short-wave radio inputs from separate aerial systems.

This diagram shows the television amplifier feeding from a low-impedance output circuit into radio-frequency busbars. These busbars have to carry the current for a short distance, and are designed to act as a line of characteristic impedance of 25 ohms. Three filters grouped at the point of common connection to the busbars serve to filter out the different frequencies into the respective channels required for television, long, medium and short-wave broadcasting; they also maintain a high impedance to the 25-ohm line at frequencies outside those at which the associated amplifier works. This is necessary to ensure that no one amplifier is shunted by the output circuits of any other, and the scheme has the advantage that the addition or removal of any section may be made without affecting the characteristics of the amplifiers remaining in operation. The filters are normally installed at the same time as the television amplifier, as little extra cost is involved, and they enable the broadcast distribution system to be put into operation over the same lines merely by the addition of the appropriate radio amplifiers and aerial system. At the receiving end it is not generally necessary to use any filters either for television or radio, since the natural selectivity of the receiver is sufficient. This is the case in the example illustrated in the accompanying photograph, which shows a combined television and all-wave radio receiver with automatic record-changing gramophone.

Central Junction System

So far, the methods described apply to permanent installations. For a temporary installation such as would be required for a public demonstration, similar equipment is used, but instead of using a number of separate junction boxes, all receivers are fed from a central junction box. A photograph of the type of box that is used for this purpose is reproduced.



Baird junction box as used for the distribution of television signals to demonstration booths at the last Olympia exhibition.

The diagram of the distribution box, given in Fig. 2, shows the manner in which the lines are fed. It will be seen from the circuit values that the combination of resistances acts so that each outlet is fed from an impedance of 100 ohms, and that the main line feeds into an impedance of 100 ohms, thus preventing any reflections along the lines with consequent undesirable effects on the signals. Between the main feeder and each outlet there is an attenuation of 35 db. thus there is an attenuation of 70 db. between any one receiver and another, which is adequate provision against mutual interference between receivers via the line. Identically, similar output to each line is obtained by the radial grouping of resistances in the screening compartments of this box. These compartments are formed between an inner and outer shell, the inner being drilled to take the 2,500 ohm ceramic resistances, and the outer drilled to take the output cable connecting flanges. Detachable covers fit over the ends, completing the screening.

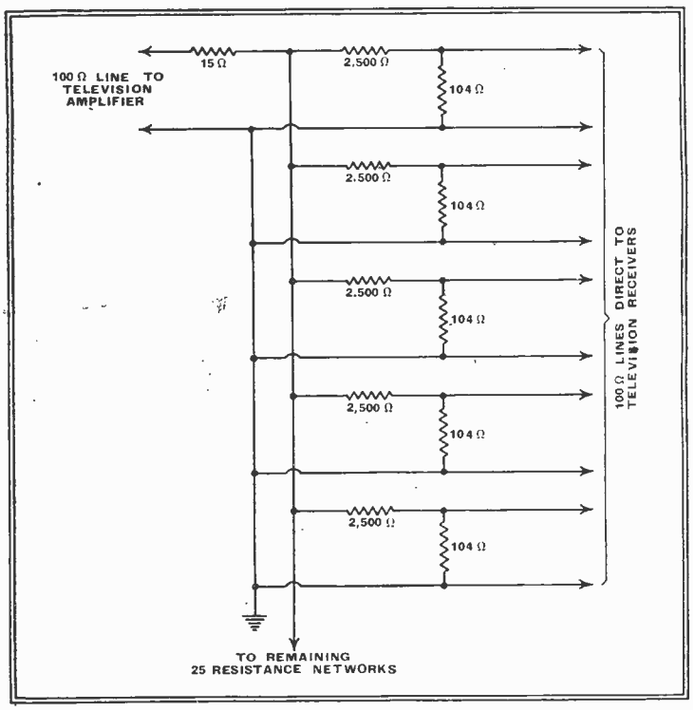


Fig. 2.—Connections of the distribution box shown in the accompanying photograph.

The success of a radio-frequency distribution system depends not only on suitable amplifiers, but also on the feeding system. The lines have to transmit currents at frequencies ranging between 150 kc/s and 47 megacycles, with a minimum of loss. The type of line to be used requires some consideration for the best results. For example, in order to reduce loss, a large diameter cable can be used, but in addition to the increased cost of the cable it becomes difficult to handle above a certain size, and its use is doubly expensive. In consequence, the choice is limited to certain types and sizes.

The possibility of electrical interference in the building makes it necessary to use screened cable, and this may be either a single or twin conductor cable. Balanced circuits may be used with the twin conductor type, giving greater immunity from pick-up. Fortunately, this is not normally necessary; for cables of the same overall size and quality, the loss in the twin is the higher. Single concentric cables are found to be the most useful, and details of make-up and characteristics of two typical examples are given in the table on this page.

Cables such as these have been found quite satisfactory in everyday use for the types of distribution systems described, and have been laid at blocks of flats at 40, Berkeley Square, Furzecroft, Brookfield, and Viceroy Court, to mention a few.

CHARACTERISTICS OF TWO TYPICAL CONCENTRIC CABLES

	Cable 0-4in. dia. overall.	Cable 0-27in. dia. overall.
Inner Conductor	14/0.0076in. stranded tinned copper.	14/0.0076in. stranded tinned copper.
Centre Insulation... ...	0.31in. diameter corrugated tube of low-loss bitumen compound, overwound with tape.	0.15in. diameter solid centre of low-loss bitumen compound. overwound with tape.
Dielectric constant ...	2.8	2.8
Sheath	Close-braided tinned copper with protective bitumen outer covering.	Close-braided tinned copper with protective outer covering.
Characteristic impedance	100 ohms.	70 ohms.
Loss at 45 megacycles ...	3 db. per 100 yards.	14 db. per 100 yards.

The author wishes to express his thanks to Baird Television, Ltd., for permission to publish this description of the company's aerial relay system.

The Wireless World Four-Band Super-Six

NEW SUPERHETERODYNE COVERING 10.5 TO 2,000 METRES

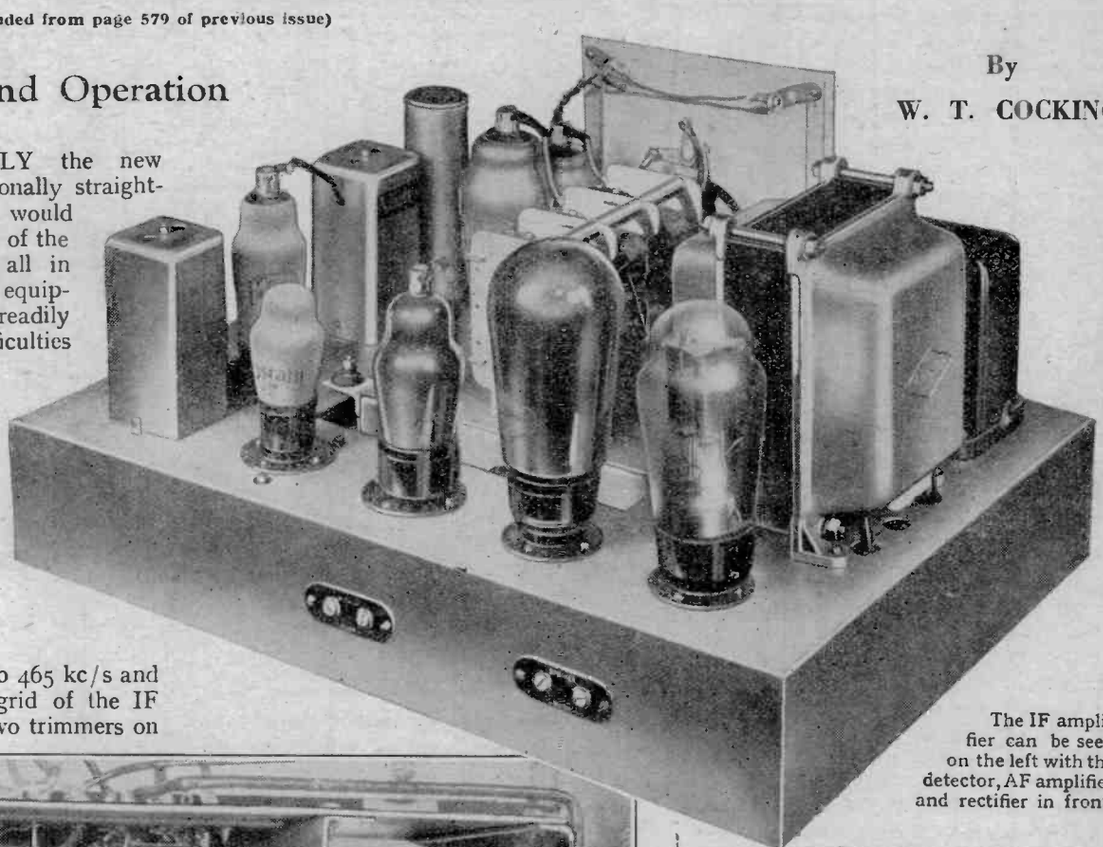
(Concluded from page 579 of previous issue)

By
W. T. COCKING

Adjusting and Operation

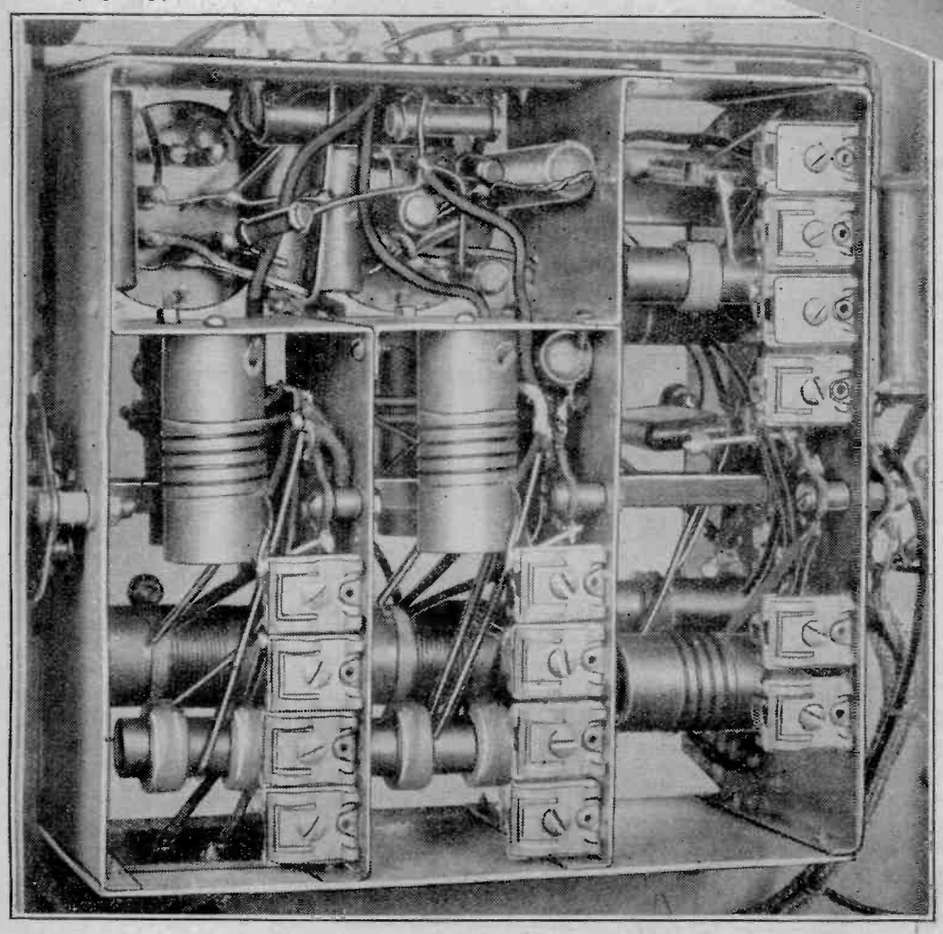
CONSTRUCTIONALLY the new receiver is exceptionally straightforward, for what would be the difficult part of the assembly and wiring lies all in the tuner. The rest of the equipment is well spaced and readily accessible so that no difficulties should arise.

The tuner is sent out ready adjusted and the trimmers contained in it should consequently need no alteration to their settings. The initial adjustments, therefore, are confined to the four trimmers on the IF transformers. These are readily adjusted with the aid of a test oscillator. This should be set to 465 kc/s and its output clipped to the grid of the IF valve (top cap), and the two trimmers on T2 adjusted for the greatest response.



The IF amplifier can be seen on the left with the detector, AF amplifier and rectifier in front.

THE considerations underlying the design of the Four-band Super-Six were dealt with in last week's issue of "The Wireless World," and in this article the construction and operation are treated. The receiver is sensitive and selective and is yet capable of giving high-quality reproduction, so that it is suitable for all classes of listening

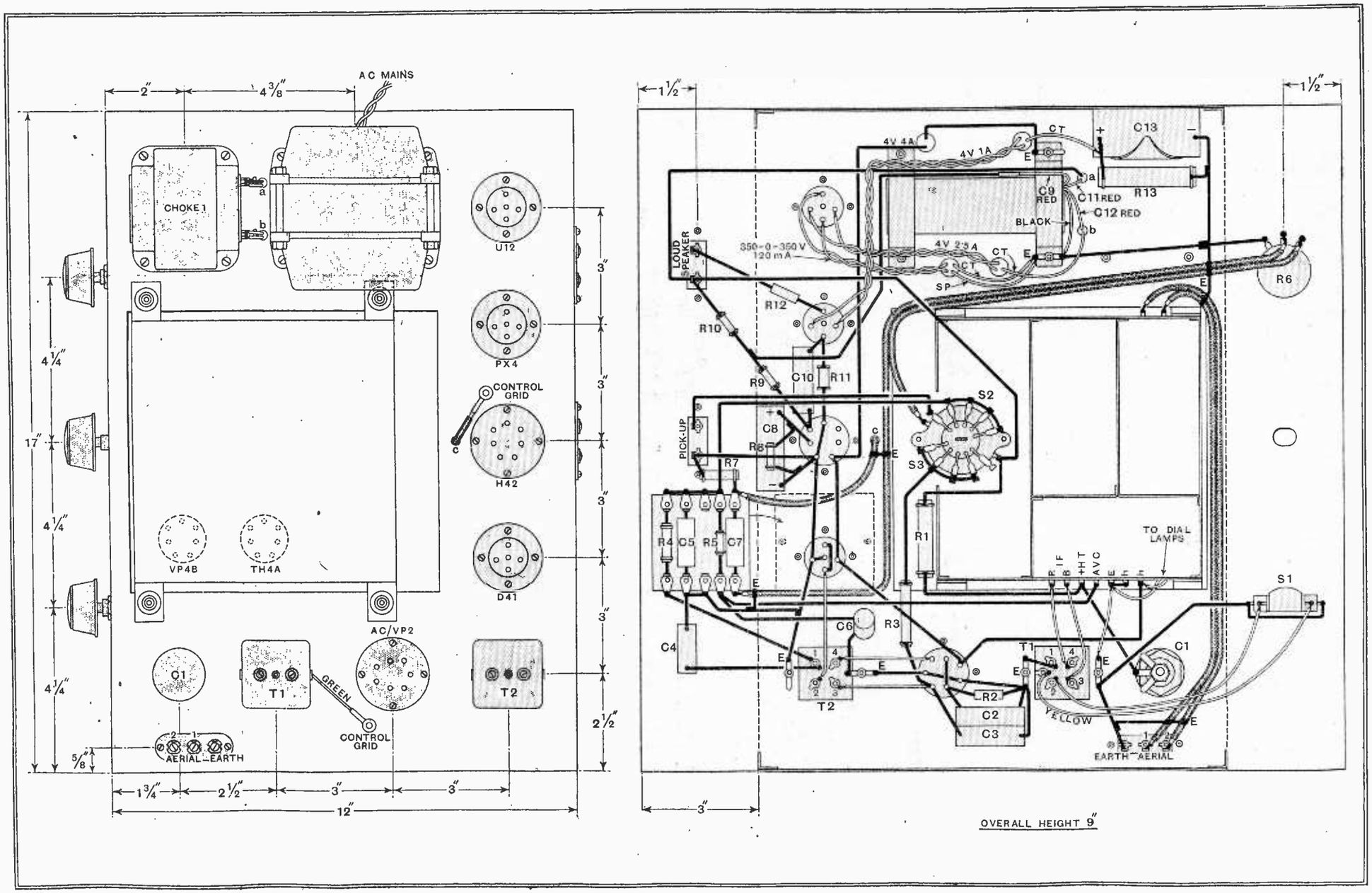


An under-view of the tuner. The oscillator section can be seen on the right

The oscillator should then be clipped to the frequency-changer grid, with the wave-range switch set for the long waveband, and the trimmers in T1 adjusted. These adjustments must be made with S1 set for high selectivity; that is, the knob must be turned anti-clockwise.

In cases where a calibrated test oscillator is not available adjustment is not so easy. There is, of course, no difficulty in finding a station and bringing all the IF circuits into resonance with one another. This is not sufficient, however, for although the circuits may all be tuned to the same frequency there is no guarantee that they are tuned to the correct frequency of 465 kc/s. Unless they are tuned to this

CONSTRUCTION, ASSEMBLY AND WIRING DETAILS OF THE FOUR-BAND SUPER-SIX



A full-size blue print of the wiring diagram is available from the Publishers, Dorset House, Stamford Street, London, S.E.1. Price 1s. 6d. post free.

The Wireless World Four-Band Super-Six

correct frequency, for which the tuner is designed, the ganging will not hold accurately, and although matters may be improved by readjusting the trimmers in the tuner, the accuracy of ganging cannot be made to reach the normal figure.

When an oscillator is not available the best course is to set the tuning control to a local station, choosing the one the frequency of which is nearest to 1,400 kc/s, 1,000 kc/s or 600 kc/s, by means of the calibrated dial. Then treat the four IF trimmers as the four tuning controls of an unganged straight set, and tune in the local station on these.

If the local station is not close to one of the three frequencies enumerated above, it is best to consider the foregoing as a preliminary adjustment only and to repeat it on another station on one of these frequencies. Three stations which are especially convenient for this purpose are Lyons (1,393 kc/s), Midland Regional (1,013 kc/s) and Brussels (620 kc/s), as they are strong signals and easily identified.

On test the receiver gave a very good account of itself. Mains hum was negligible and the signal-noise ratio good. At low selectivity a very high standard of quality was obtained. At high selectivity, sideband cutting is noticeably increased, but this is inevitable if interference is to be avoided. The difference in selectivity between the two settings of the control switch is noticeable both as a change in quality and a change in the amount of interference. On the long waveband, for instance, it is readily possible to receive the Deutschlandsender clear of serious interference from Droitwich and Radio-Paris, but at low selectivity the station can only be just heard through a welter of interference.

This is, of course, an extreme test. A more normal one is on the medium waveband. Receiving Cologne at high selectivity there is no interference from the stronger signal provided by North Regional. Turn the switch to low selectivity and side-band splash becomes evident.

During the tests no self-generated whistles of any kind were observed on the medium and long wave bands. On the short waves the same immunity from image interference cannot be obtained, and at times a certain amount of this interference was observed. It was not at all serious, however, and the high adjacent channel selectivity is preserved.

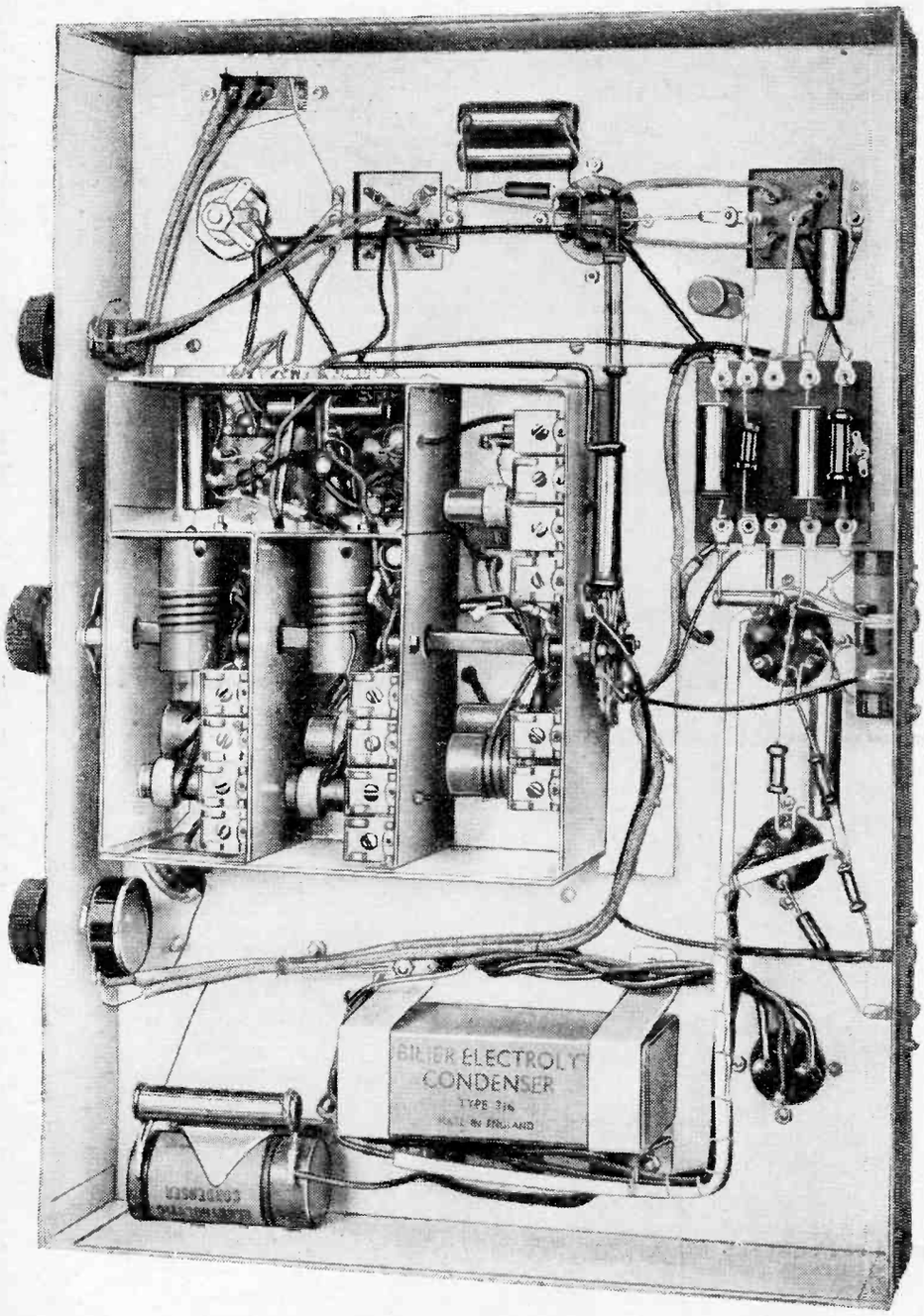
Several American broadcasting stations were received during the tests at full loud speaker strength, and the short-wave performance was found, in fact, to be very consistent. Tuning is, of course, critical, but as the dial is of the dual-ratio type giving a high gearing, it is by no means difficult to handle the receiver. A light touch is naturally advisable.

The receiver should, of course, always be tuned at high selectivity, and the selectivity reduced if interference conditions permit after the desired station has been tuned in. No difficulty should be found in determining the precise tuning point, for the correct setting, as always, corresponds to the deepest toned reproduction. If desired, of course, a tuning indicator can be fitted, but is really rather an unnecessary refinement. In the writer's experience it is as easy to tune a receiver by ear as by eye.

If a tuning indicator is wanted, however, the cathode-ray type such as the Mullard TV4[1] or the Mazda ACME[2] is advised. It must have its heater connected across a convenient point on the heater wiring, and the indicator connected up in accordance with its maker's recommendations. The input to the indicator should be taken from the junction of R4 and R5.

The use of a milliammeter-type indicator is not advisable in this receiver owing to the difficulty of connecting it. The IF valve is not controlled for AVC, so such an indicator could only be connected in series with the HT lead to the tuner, and it will then carry both anode and screen currents of the two valves as well as the oscillator anode current. Some of these currents do not change appreciably with AVC, so that the percentage change of total current would be less than one would normally have for this type of indicator.

The receiver is provided with a calibrated scale, but it may be as well to mention that the precise waveband coverage measured on the original model is 29.15—10.5 Mc/s (10.3—28.6 metres), 11.45—4.18 Mc/s (26.2—71.7 metres), 1.532—0.519 Mc/s (196—578 metres) and 0.46—0.147 Mc/s (652—2,040 metres).



The under-side of the complete receiver is shown in this photograph.

[1] *The Wireless World*, Oct. 9, 1936.
[2] *The Wireless World*, May 21, 1937.

Listeners' Guide for the Week

Outstanding Broadcasts at Home and Abroad

SIXTEEN "Scrapbooks" have so far been broadcast during the four years since the series began. It is the intention of the collaborators, Leslie Baily and Charles Brewer, to revise and revive one or more of the early editions for inclusion during the next few months in response to the requests of many listeners. The first year to be dealt with was 1913, and on Friday and Saturday at 7 (Nat.) and 6.30 (Reg.), respectively, this Scrapbook will be revived. It is pointed out that very considerable revisions have been made and new material and new personalities introduced.

Personalities who will come to the microphone are Robert Hale, the revue star, in his sketch, "The Musical Watsons," from "Eightpence a Mile"; Ethel Levey, that year in the revue, "Hullo, Ragtime," at the London Hippodrome, which introduced to this country many of the ragtime songs which became the craze just before the Great War; Adolph Zukor, Hollywood film magnate (his reminiscences for this programme were recorded during his recent visit to England); Walford Hyden, in a reminiscence of Anna Pavlova; C. J. Pennington, who was the radio operator of S.S. *Volturno*, the famous "wireless rescue" of which will be re-enacted; and also the recorded voices of Lord Roberts, Chaliapin, and Marie Lloyd.

CINE-VARIETY

FOR the opening night of London's latest giant cinema, the Gaumont State at Kilburn, an all-star variety bill has been prepared, and Regional listeners will be treated to 45 minutes of the show from 8 on Monday.

Gracie Fields, Henry Hall and his Orchestra, Stone and Lee, and Alfred Van Dam and his State Orchestra, with Sidney Torch at the organ, will all be included in the broadcast. The B.B.C. has arranged to place microphones throughout the cinema to pick up both the stage performance and the atmosphere of the house.

NIGHT SHIFT

THE next broadcast in this series, which aims at portraying to listeners some of the activities which continue after most of us have finished our day, will come from King's Cross Station. On Monday, at 10.30 (Nat.), we shall be "eye witnesses" to the putting to bed of a great locomotive in this London terminus.

Commentators and engineers will ride on the footplate of the Coronation engine as she makes her way from the platform at King's Cross to the sheds. Listeners will hear this famous engine being turned round on the turntable and taken to the mechanical coaling chute and being prepared for her run on the following day.

Driver Taylor, of the Coronation Scot, who recently created a record for railway engines of 113 miles per hour, will be heard talking with commentators and engineers.

AT THE SHIP INN, in this little port of Mevagissey, Cornwall, local characters will meet round the kitchen fire during a programme devised by Bernard Walke which Regional listeners will hear on Monday at 7.30.

COMPOSERS BROADCASTING

ON Sunday at 5.30 (Nat.) we shall hear some of Cyril Scott's songs and piano pieces, the soloist being Kate Winter with the composer at the piano.

Modern French music will be broadcast for National listeners on Wednesday at 7.45 by the B.B.C. Orchestra, Section D, conducted by Julian Clifford. The programme will include the first performance of Darius Milhaud's suite for two pianos, "Scaramouche," played by the composer and Marcelle Meyer. Milhaud will, in the same programme, conduct the first performance in England of his "Suite Provençale."

AN OLD FAVOURITE

ERNEST LONGSTAFFE has assembled some notable stars for his Christmas week gala production of "Palace of Varieties," which will run for an hour in the National programme from 8 o'clock on Tuesday.

Older listeners will doubtless appreciate the first appearance before the microphone in this show of Gertie Gitana singing some of the old favourites. Frances Day, star of stage, screen and radio, is on this bill, which also includes the Western Brothers, Fred Douglas, Stanford and McNaughton, and Stanelli with his Hornchestra.

OPERA

THE only opera event of Friday appears to be "Der Wildschütz" (The Poacher), by the actor-composer, Lortzing, which Deutschlandsender is giving at 7. This excellent comic opera has been a steady favourite for

HIGHLIGHTS OF THE WEEK

THURSDAY, DECEMBER 16th.

Nat., 7.30, Circus Acts in Training: relay from Bertram Mills' winter quarters. 7.50, "Playing the Game": a football extravaganza.

Reg., 7.30 and 9.5, Handel's Oratorio "Messiah" from the Victoria Hall, Hanley.

Abroad.

Bordeaux-Lafayette, 8.30, Planquette's operetta "Les Cloches de Corneville."

FRIDAY, DECEMBER 17th.

Nat., 7, Finnish European Concert from Helsingfors. 8, Revival of "Scrapbook for 1913."

Reg., 7.30, Leslie Hutchinson (Hutch) in "The Melody Man." 9, Bert Firman and his orchestra.

Abroad.

Kalundborg, 8, "The Christmas Oratorio" (Bach) from Christiansborg Castle Church.

SATURDAY, DECEMBER 18th.

Nat., 3, English Rugby Union Trial Match. 3.50, Rugby: England v. Australia. 8, Music Hall. 9.35, Antonio Stradivari programme.

Reg., 4.10, "Playing the Game." 6.20, "Scrapbook for 1913." 8.20, "Birth of a Giant": a panorama of the shipyards of Belfast.

Abroad.

Vienna, 6.50, Offenbach's comic opera "La Vie Parisienne."

SUNDAY, DECEMBER 19th.

Nat., 5.30, A Cyril Scott programme: Kate Winter and Cyril Scott. 9.35, "Mr. Pratt's Waterloo": a comedy by Val Gielgud and Philip Wade.

Reg., 6.30, Sunday Orchestral concert. 7.55, Service from St. Giles' Cathedral, Edinburgh. 9.5, Melodies of Christendom.

Abroad.

Berlin, 6.30, Mozart's "The Magic Flute."

MONDAY, DECEMBER 20th.

Nat., 6.20, Music of Eric Coates conducted by the composer. 7, Monday at Seven. 8.30, Broadway Matinée. 10.30, Night Shift: the locomotive depot at King's Cross.

Reg., 7.30, At the Ship Inn: relay from Mevagissey. 8, Stage Show at the opening night of the Gaumont State Cinema, Kilburn. 9.30, Benny Carter and his orchestra from Paris.

Abroad.

Deutschlandsender, 7, Fifth Philharmonic concert: soloist Henry Holst.

TUESDAY, DECEMBER 21st.

Nat., 5, Relay from Amsterdam. 8, Palace of Varieties. 9.35, "World's End": a new nativity play by J. D. C. Pellow.

Reg., 7.30, Dance tunes of yesterday. 8, Feature: Sir Joshua Reynolds. 9, Folk Songs and Dances from the King Arthur Hotel, Reynoldston.

Abroad.

Rome, 8, "Il Trovatore" (Verdi) from the Royal Opera.

WEDNESDAY, DECEMBER 22nd.

Nat., 6.40, From the London Theatre. 7.45, Modern French Music. 9.20, Peter Dawson with the B.B.C. Male Voice Chorus. 10, Folly and Mistletoe: a revue for Christmas week.

Reg., 8, Variety from the Argyle Theatre, Birkenhead. 9, "We are not Alone": a play by John Hilton.

Abroad.

Paris PTT, 8.30, One hundred years of French operetta—from Offenbach until to-day.

ose on a century. Saturday's one real opera, "Le donne curiose," which comes from the Royal Opera, Rome, relayed by Milan at 8, is a fascinating example of pure comedy.

On Sunday, at 6.30, Berlin gives us Mozart himself at his lightest and brightest in "The Magic Flute," with Walter Ludwig as Tamino and Erna Berger as Queen of the Night. The same evening brings us another Lortzing opera, "Tsar and Carpenter," from Frankfurt, at 7, Act I of which was recently relayed by the B.B.C.

Something new comes from Munich on Sunday at 7, "Schwanenweiss" (Swan-White), a fairy opera after a tale of Strindberg, the composer of which is Julius Weismann, a southern German and a sensitive, romantic miniaturist in whom the element of fantasy is very strong.

"Gwendoline," which comes from Radio-Paris on Monday at 8.30 (a studio performance), is the masterpiece of Chabrier, one of the great composers of the last century, who died in 1894.

THE AUDITOR.

THE BICENTENARY of the death of Antonio Stradivari, the great violin maker, who on all his instruments Latinised his name as Stradivarius, has been commemorated in Italy by the issue of a special stamp, a reproduction of which is here shown. On Saturday, the anniversary of his death, Arthur Catterall, playing on his own "Strad" will, at 9.35, give a recital of "Chaconne" by Vitali, a compatriot of Stradivari born in the same year.

Broadcast Brevities

NEWS FROM PORTLAND PLACE

His Majesty's Message

THE announcement last Friday of the King's decision to broadcast a message to the Empire on Christmas Day came as a welcome surprise. There had been speculations on the question in many quarters, and on enquiry at Broadcasting House, when preparing our last issue which included the Christmas programmes, we were told that no arrangement had been made.

In making this decision the King will be following the example of his father, whose regular messages to "this great family" were eagerly awaited by all. The Christmas Day broadcast, which will be given at 3 o'clock from Sandringham, will be heard from all B.B.C. stations, including the short-wave transmitters at Daventry.

International Relays Not Wanted?

CHRISTMAS, 1937, will be remarkable for the absence of long-distance relays. Whether the "Round the Empire" feature is a great loss is open to question; letters from the Dominions and Colonies have suggested that the whole idea has been played out, so soon do we lose our sense of novelty!

After all, is listening to a sheep farmer in the Antipodes more remarkable than "seeing" a person by television a hundred miles away?

Televising from Farmyards

Next year television may take over the Christmas afternoon features, with sights and sounds from castle and cottage within the service area of Alexandra Palace. If one looks at the map it is surprising how much and varied terrain is contained within a thirty-mile radius of A.P.

Farmyard scenes have already been discussed for a television "O.B."

Mike Tours of Welsh Villages

IF the international cables are not busy for broadcasting, the home lines are being extensively used for relays of different kinds. Take the latest plan for Wales.

Engineers and commentators will shortly begin roaming the Welsh countryside to put out a series of feature programmes entitled "What Has Your Village to Offer?"

Wireless enthusiasts will get amusement from picking up the voice of the local postmistress via Washford and comparing it with the same dulcet tones as heard over the counter.

Staggered by Stagshaw

THE North is slow to express itself, which perhaps explains that tributes to the new Stagshaw transmitting station are only just beginning to filter through in large numbers to Broadcasting House.

Apparently vast numbers of people in Northumberland and Durham are beginning to experience good reception of English programmes for the first time since broadcasting began and are only now getting over the shock.

Incidentally, the B.B.C. engineers claim that ninety per cent. of the population of this country can now rely on satisfactory reception from at least one station.

South Coast Listeners

The hundred per cent. mark will be brought appreciably nearer when Start Point fills in some of the appalling gaps along the South Coast.

Informed opinion has it that this transmitter may give a good signal as far away as Brighton, which has always suffered from screening in the direction of London.

Demolitions in Birmingham

BIRMINGHAM is agog over the demolitions now going on in Islington Row, where the B.B.C. has an option on the property, and everyone is asking whether this means that new broadcasting headquarters are about to be erected.

Actually the present activities mean—just nothing.

Option to Purchase

It is one of the terms of the B.B.C.'s lease that the existing buildings should be pulled down. Whether the Corporation will exercise its option to purchase is not yet decided.

Even if a new "Broadcasting House" were built on the site this would not solve the inevitable problem of where to build a television transmitter.

Better News for Aberdeen

Aberdonians have more cause for satisfaction, for work has just begun on the new studios at Beechgrove House, in the centre of the city, and if all goes well they should be ready for use before New Year's Day, 1939.

Five studios are provided for in the plans — one fair-sized orchestral studio and four smaller ones for drama and talks.

New D.C. Panel

Aberdeen, it seems, is to launch out with feature programmes, for a new dramatic control panel is now being constructed.

The work is in the hands of a Manchester firm, who are also at work on the 5 kW relay station at Nigg, about a mile to the south of the Granite City.

Better Film Television

TELEVISION of film from Alexandra Palace has improved enormously in the past few months, though it still lags behind the transmission of "live" material from the studio. It is believed that the two will be hardly distinguishable within a week or so when new teleciné apparatus is installed.

Searchlight on Talks

VALUABLE light has been shed on the whole question of B.B.C. talks and the reactions of the listening public by the recent enquiry into listeners' opinions on cinema talks.

The series was broadcast by six different speakers during July, August and September last, and although it would be invidious to refer to names it is worth looking for general inferences.

That Microphone Voice

Listeners were asked to discuss the microphone voices and personalities of the speakers. The voting showed that the most attractive features were friendly intimacy, lack of affectation and clarity of diction. One voice, although clear, was considered monotonous; another was pitched too high; a third so low as to be guttural.

The cardinal crime attributed to one speaker was indistinctness.

The Ideal Length

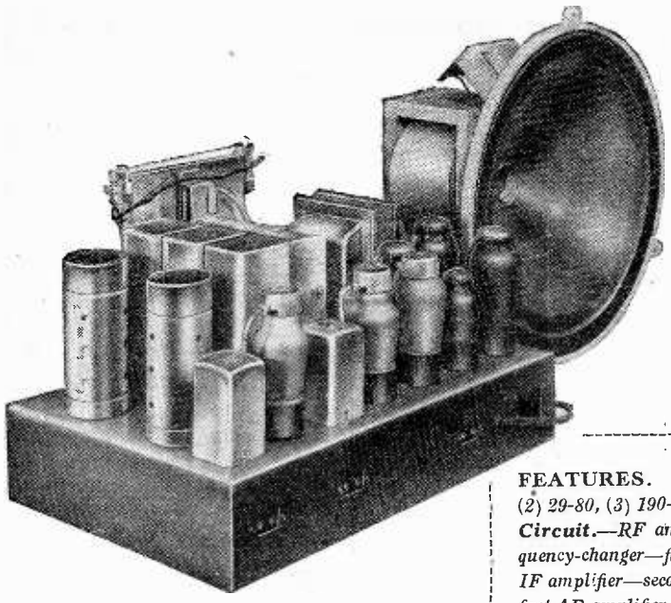
Voting on the ideal length of talk revealed a preference for twenty minutes. Many plumped for quarter-hour talks, but the majority considered ten minutes too short for anything but scrappy treatment of the subject.

As might be expected, men make better listeners than women. Although the subject was cinema, in which most women seem more interested than men, the male voters outnumbered the females by more than two to one.

Sunday Night is Talks Night

As to the most suitable time for listening to talks, the statistics showed that the favoured hour is between 9 and 10 on Sunday evenings. After 10 there is a steep drop both on Sundays and weekdays.

Decidedly fewer people are free to listen to talks at any time on Saturdays.



McCarthy

MODEL PP9AW

Generous Output and High Sensitivity from a Well-made Chassis

FEATURES. ***Ranges:***—*(1) 12.8-33, (2) 29-80, (3) 190-550, (4) 800-2,000 metres.* ***Circuit.***—*RF amplifier—triode hexode frequency-changer—first IF amplifier—second IF amplifier—second detector, AVC rect. and first AF amplifier—phasing valve—push-pull pentode. output valves. Full-wave valve rectifier.* ***Controls.***—*(1) Tuning. (2) Volume and on-off switch. (3) Waverange. (4) Sensitivity. (5) Tone.* ***Price*** *(excluding loud speaker) — 14 guineas.* ***Makers.*** *— McCarthy Radio Ltd., 44a, Westbourne Grove Bayswater, London, W.C.2.*

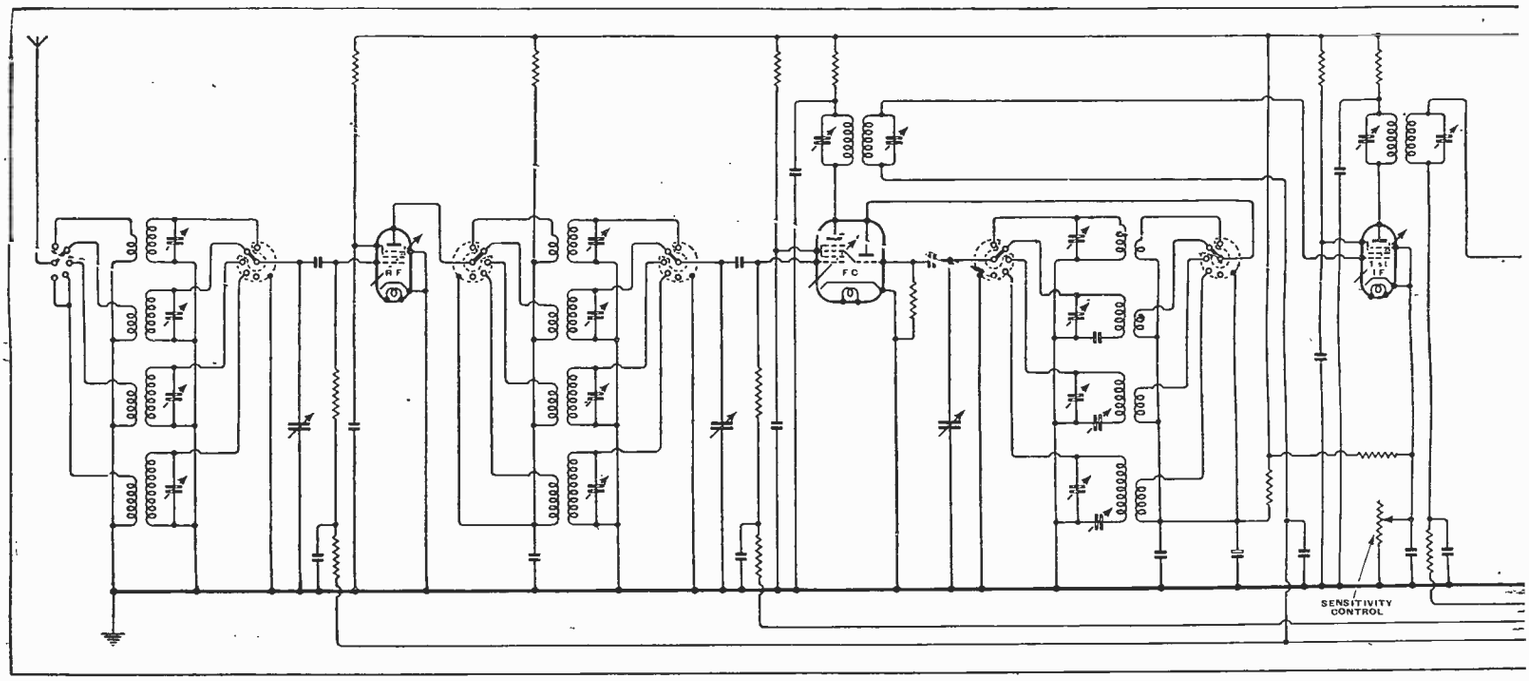
TO some people it may seem surprising that there is a demand for a receiver chassis which costs appreciably more than the average level of prices current for complete table-model receivers. Apart from the strong individuality which urges many people to adapt special cabinets for housing their receivers and the appeal to those who, not without good reason, insist upon a loud speaker which shall be mounted separately from the chassis, there is little doubt that one obtains good value for money for the increased performance available when the cost is entirely devoted to essentials. Few sets are able to show in their specification two IF stages in addition to an initial stage of RF amplification, and the power output approaching 9 watts which is available from the push-pull output pentodes is one which calls for a separately mounted loud speaker, at all events in the hands of the amateur cabinet designer.

For so generous a power output, combined with a high over-all amplification, the designers have wisely relied upon an essentially simple and straightforward circuit. The RF amplifier, which is tuned on each of the four wavebands, is transformer-coupled to a triode-hexode frequency-changer, which is followed by two stages of IF amplification functioning at 465 kc/s. The double-diode-triode second detector is connected in the usual way for signal rectification, delayed AVC and first stage AF amplifier. There is, however, a noteworthy modification in the distribution of AVC. The two IF amplifiers and the input RF stage are controlled from the main line with delayed action, but the control of the frequency-changer is derived by smoothing from the signal rectifier circuit and is without a delay bias. An improvement in the short-wave performance, particularly in the matter of signal-to-noise ratio, is obtained by this arrangement.

After the stage of amplification incorporated in the second detector valve comes a resistance-coupled phasing valve for the inputs to the push-pull pentode output valves. No output transformer is incorporated in the chassis, so that the speaker, which should have a field resistance of 1,000 ohms and be capable of dissipating at least 10 watts, should also be fitted with a suitable centre-tapped output transformer to match the anode-to-anode impedance of the Pen.A4 pentodes.

The loud speaker supplied with the chassis for test purposes was an Epoch, which was in every way well suited to the requirements of the receiver.

An RF amplifier and two stages of IF amplification ensure high over-all sensitivity which is controlled by variable bias in first IF stage.



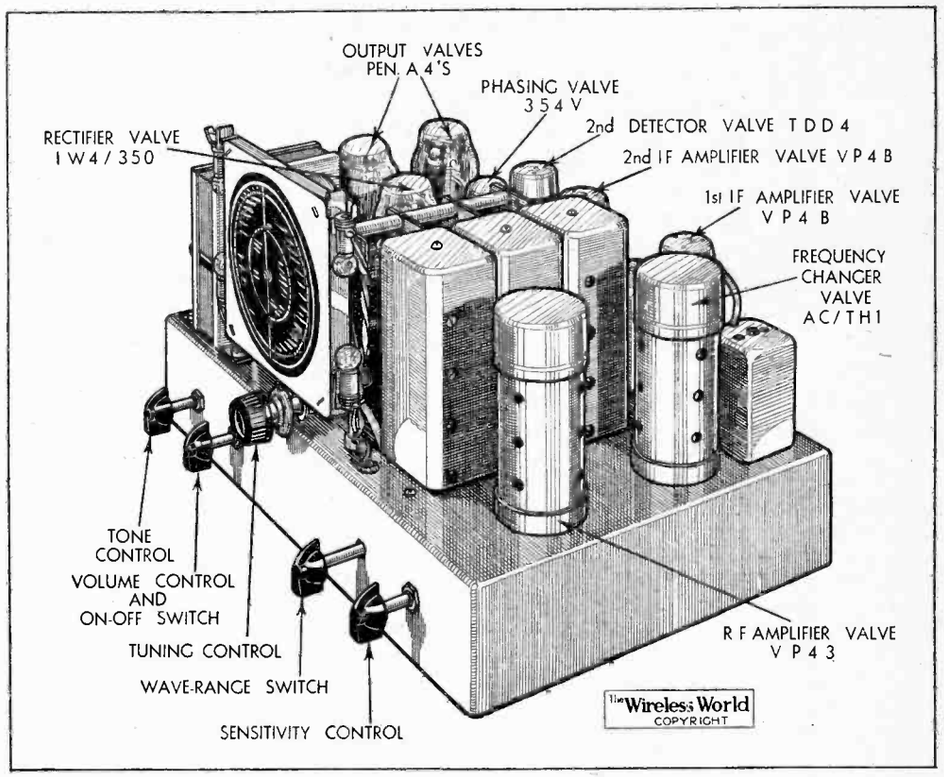
We were very favourably impressed with the neatness of wiring and the general mechanical soundness of the chassis construction. Tuning coils and waverange switch are built as a single unit, which is let into the steel chassis through a rectangular aperture at the side of the porcelain insulated three-gang tuning condenser. The condenser is really well insulated also from a mechanical point of view, and even at the full output of the set there was no sign of microphonic feedback even when the loud speaker was brought within a few feet of the chassis.

Short-wave reception is divided into two ranges, and the extension of the shortest waverange down to 12.8 metres is no mere catalogue figure, for the sensitivity is quite as high at the bottom end of this range as it is on the 16-metre and 19-metre broadcast bands where most manufacturers make certain that the highest sensitivity is available. Conditions of reception were not too good at the time the set was tested, and yet American stations which were difficult to receive clear of background noise on standard commercial receivers with something of a reputation for good short-wave results were quite easily brought in clear of background noise on the McCarthy chassis.

Sensitivity Control

There is a sensitivity control which gives varying degrees of amplification in the IF stages, and though due to the action of AVC this control does not have much effect on medium and long wavelengths, on the short waves its real function of reducing background noise is appreciated. However, it is only under the severest conditions that anything less than the full sensitivity of the set need be used, and from the point of view of signal-to-noise ratio we would put this set in a very high class indeed.

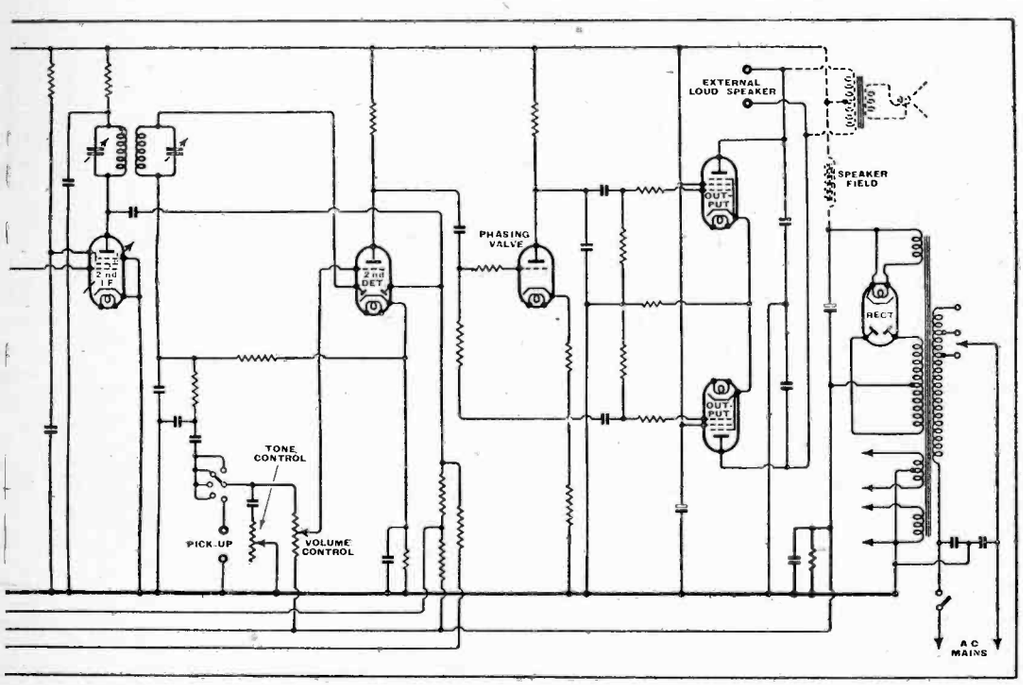
On the medium-wave band the uniformity of over-all magnification over the scale is again noticeable, and reception is unmarred by heterodyne whistles or unnecessary valve noises. The selectivity is such that 1½ channels are lost on either side of the London Regional station, but on long waves, as might be expected, the selectivity is somewhat higher, and anyone who wishes to listen to the Deutschlandsender can do so without difficulty. There can be no doubt that the power output rating is amply substantiated by the volume of sound emitted from the loud speaker. A little more bass might have been provided with advantage, and the experienced listener will without difficulty identify the type of valves used in the output stage. Even with the comparatively high selectivity on long waves and the consequent cutting of sidebands it is not possible to use anything like the full range of high-frequency response allowed by the tone control.



Notable features of the chassis are the thorough screening of the input valves and the excellent mechanical insulation of the tuning condenser.

These criticisms must not, however, be allowed to outweigh the merits of the performance from the quality point of view, and there is no denying the advantages of having an ample reserve of power, particularly at the present season when impromptu dances may be called for at parties.

No doubt the difficulties of mounting have decided the makers to omit a tuning indicator, though this is a feature which we might reasonably have expected in a receiver at this price. The dial lights are spectacular, but require some addition to show which of the pairs of lights on the left-hand and right-hand halves of the tuning scale apply to the respective tuning scales. No doubt the people who will be attracted to this receiver will have their own special ideas as to how this should be done, and it is, therefore, in keeping with the main intention of this chassis, namely, to provide the basic performance, and to leave the adaptation and installation to individual taste.



THE AVOCOUPLER

In the Avo advertisement in last week's issue the 9-pin adaptor unit should have been described as the Avocoupler. The last four letters of the name were inadvertently omitted.

UNBIASED

By FREE GRID

Television Needs Matrimonial Experts

WE have had all sorts of reasons trotted forward by professional apologists to explain why it is that the public don't buy television sets with the same avidity that they do ordinary broadcast receivers. I am, of course, referring to that section of the B.B.C.'s downtrodden patrons who live within range of the Alexandra Palace, for, after all, it is of little use a person in the Manchester area buying a television set no matter how many times over he could afford it.

To anybody but an expert it should be quite obvious that the reason is simply one of £ s. d., or, to put it more bluntly, the average man can't afford even the miserable £38 which is, I believe, the price of the least expensive televisor. It must on no account be thought, however, that I am in any way blaming my old friends the manufacturers who would, I feel sure, gladly sell even their racehorses if by so doing they could benefit their fellow men.

The whole point is, as one prominent manufacturer tried to impress upon me when we were lunching in Soho the other day, that until there is a big demand for television sets, it is impossible for a manufacturer to lay down the expensive plant necessary to mass-produce the instruments, and so bring down the price of them. Needless to say, there is going to be no big demand until prices do come down.

The deadlock seems to me so absolute that in my opinion it can only be solved by a magistrate used to dealing with matrimonial disputes, and I for one am not going to waste my time by trying to solve it. Eventually, I suppose, we taxpayers will have to dip our hands into our pockets once more in order to set the ball rolling, lavish promises being given to us, as usual, that we shall get our money back a thousandfold as in the old 9d. for 4d. days of which the more mature of my readers will probably have painfully vivid recollections.

Lunching with a prominent manufacturer.

I came across a very startling commentary on the highness of the existing prices the other day when talking to a friend. His financial position is such that he could afford half a dozen of these sets if he wanted to, but like all self-made men, he always believes in getting full value for his money, and when he first thought of buying a televisor he sat down to work out the necessary financial details. As a result of this he found that although he lives south of the Thames, a full thirty miles from the Alexandra Palace, it would be cheaper for him to hire a Rolls-Royce complete with chauffeur, and get himself driven to the Alexandra Palace every evening to see the actual performance in the studio, rather than to pay for a television set.

After a little feverish mental arithmetic I entered a strong protest against this statement which seemed to me to be all wrong. But my friend, who is nothing if not thorough, in his financial calculations, pointed out to me that I was taking into consideration only the initial cost of the set whereas the proper thing to do was to include the depreciation of valves and cathode-ray tube as well as what he called the obsolescence factor of the whole set. As a result of his calculations he wrote to the B.B.C. asking to be accommodated with a seat in the studio every evening for which he offered to pay a reasonable price based on the charge for a seat in a cinema. At present, however, he is still awaiting a reply.

The Silent Horn

MY recent revelations about a certain go-ahead foreign city where all fire engines and police cars have been fitted with short-range 1-metre transmitters, by means of which they are able to set all suitably-equipped traffic lights in their favour, has brought me in a host of other letters from town-proud listeners in various parts of Europe who are justly jealous of this accomplishment.

One letter in particular is of very great interest as the writer of it tells me that the authorities in his city are planning to make a great drive to clear up the problem of traffic noise. Careful investigation has shown that a very large proportion of the noise is caused by the sounding of motor horns and similar devices as it is over here, more especially at night. As is well known, in certain districts in this country sounding motor horns at night is an offence against the law. My correspondent tells me, however, that in the case of his city far more scientific means are to be adopted to solve the problem, as the principle of the silent horn is to be adopted.

In its most primitive form the silent horn merely consists of a small electric horn fitted *inside* the car close up by the driver's ear. This horn is not operated by the driver and is *not* intended to be heard outside the car. Actually the horn is coupled to a small fixed-tuned wireless receiver working on a wavelength of about half a metre, this being operated by micro-watt half-metre transmitters fitted to other cars.

The range of these transmitters is so restricted, owing to the fractional watt power behind them, that they do not operate the horn of other cars until they are within a few yards of them. Owing to the fact that the horn is fitted close by the driver's head, and is of very small size, only he hears it, and so no disturbance is caused. This naturally leaves the unfortunate pedestrian at a disadvantage, since he cannot hear the warning of an approaching car.

Unfortunate pedestrians who may value their lives.

There is, of course, nothing to prevent pedestrians who value their lives from equipping themselves with a miniature receiver and an unobtrusive earpiece of the deaf-aid type. A one-valve outfit should be sufficient and it need be no larger than a cigarette case. It is considered, however, that this is up to the pedestrians, the government of the country having done their share by ridding the streets of one of the most prolific sources of traffic noise.

Free Grid Regrets

MAY I take this opportunity of thanking the many readers who have sent me offers of assistance in connection with the television demonstration which, as I explained last week, I have been ordered to give at the annual children's party. There seems, however, to be some little misunderstanding in the matter, as many correspondents seem to have got the idea into their heads that I am trying to work out a scheme whereby I can deceive the audience into thinking that they are seeing genuine television when all the time they are not. Such deception would, of course, be quite foreign to my nature, and while thanking my correspondents for their well-meant advice I regret that I cannot avail myself of it. In any case most of the schemes are quite impracticable, and with regard to one or two of them which do sound promising there is, I am sorry to say, no time to make the necessary preparations to put them into effect.

What Should the Big Set Have?

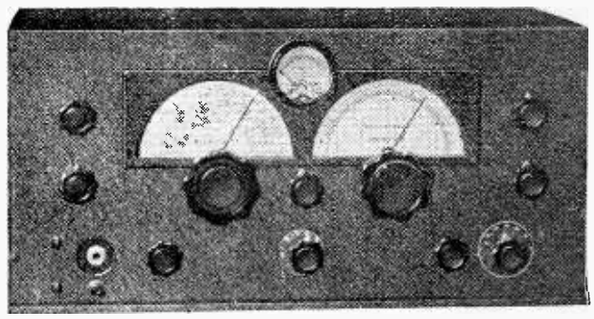
By

"CATHODE RAY"

TWO weeks ago, to clear the ground for a discussion on what features in a "big set" are most worth having, I divided listeners up into two classes—the fools for which foolproofing is necessary, and the knob-twisters. Neither of these terms is intended to be uncomplimentary; they are just memory-refreshers. A radio receiver can be made very elaborate for either sort of person, but for the former the works are carefully concealed, whereas the latter are taken into confidence, so to speak, and given a large part of the responsibility for the quality of reception obtained. I also pointed out that in the many families consisting of one enthusiast and a residue of non-technical listeners there are special difficulties in designing one receiver for the enjoyment of all. The "fools" require lots of "A — C" features, such as AVC, ATC, ASC, etc., whereas the knob-twisters want "Variable ——" features.

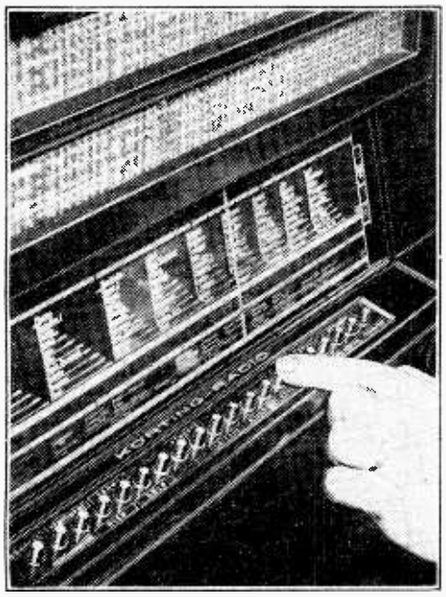
Before weighing-up the merits of these devices it seems to be quite necessary to distinguish not only between classes of *listener* but classes of *listening*. There are two quite distinct ways of listening. The more virtuous (and therefore the rarer) way is to select the programme with as much care and devote as much of one's attention to it as if one had paid for expensive seats to hear it. The other, and commoner, way is to use the broadcast fare as an accompaniment or a background of sound. This is not another *listener* classification, as I for one would be found extensively in both classes. The same person adopts different attitudes to reception on different occasions. And this affects the receiver. For example, take volume expansion or contrast amplification, as it is sometimes called: a device for making the loud bits of the music louder and the quiet bits quieter. Contrast expansion is necessary to reproduce the original scale of *pp* and *ff* of many programmes, particularly gramophone records, where a good deal of compression has been done to prevent the *ff's* from bursting the banks of the record groove and the *pp's* from being lost in needle scratch. So for the concentrated and attentive sort of listening there is something to be said for contrast expansion. But when the radio is serving as a background to a game of bridge, even the moderated variations in volume allowed by the B.B.C. control room is liable to give rise to alternate exclamations of "Oh, shut that thing down; I can't hear you!" and "Turn it up a bit, or it's not worth having on at all!" What is wanted, then, is volume *compression*, or audio-frequency AVC, to keep the murmur of dance music, herring fishery forecasts, and German lessons at constant loudness throughout the evening.

Features for Both Multi-knob and Foolproof Receivers



The antithesis of the push-button set is the American "communications" receiver, of which the RME 69 is an excellent example. A multi-knob control system of extreme flexibility is provided so that the enthusiast who knows what he is doing can adjust the receiver characteristics to meet the needs of the moment.

Courtesy, Webb Radio.



Press the right button and the set does the rest: the idea of foolproof operation is well exemplified in the latest German Körting receiver. There are buttons for 20 stations.

Neutralising Control-room Activities

While contrast expansion is correct in principle for listening proper, I personally am doubtful whether the rather large amount of extra apparatus that is necessary to effect it without serious distortion is worth while, seeing that there is no way of ensuring that the expansion takes place at the right time and degree to neutralise the activities of the control room. For my further arguments on this see the issue of October 4th, 1935.

Tone control is usually a much simpler affair. The common commercial tone control, consisting of a variable resistance in series with a condenser across the output transformer primary, is hardly worthy of the name. Some of the better types of receiver now available have a properly thought-out system for modifying the tone in order to make the best of whatever conditions exist. When a weak station is being received, for which the maximum selectivity is necessary, the high tones are inevitably cut away by the tuning circuits, and there is a tendency for the low tones to be strengthened, whereas to give a reasonably good balance they ought to be cut down, too. To render the receiver workable by the moderately intelligent person, and to avoid too many knobs, this tone control is ganged with the variable selectivity control. For the complete dunce it is, of course, necessary to make the variation of selectivity automatic and bring the tone change in with it. But the technical listener wants the tone under his own control, and some well-considered flexible scheme* is his choice, though it does mean two or three more knobs.

These are not the only occasions when straight-line amplification is wrong. Gramophone reproduction needs base uplift. The multi-knob system in the hands of the intelligent does all that is required here, but the correct amount of compensation could be included in a mini-knob set by ganging it with the waveband-gram. switch (though I have never seen it done).

Then there is the fact that the proportion of bass that suits most sorts of music makes voices boom. This is part of the much-discussed subject of "scale" distortion (24/9/37 and subsequent correspondence). Although a system for discriminating between music and speech (devised in America for cutting out advertising from the programmes!) has been made to work, and presumably could be applied to modify the tone suitably for the benefit of the no-knob "fool," this is another feature I have never actually seen. The ordinary

* *e.g.*, "Amplifier Correction and Waveform," June 25th, 1937; "30-Watt PA Amplifier," October 10th, 1937; "Flexible Tone Control," October 10th, 1937.

What Should the Big Set Have?

person is provided, on several sets on the market, with a "Speech-Music" switch; while the flexible tone control continues to serve the knob-twister.

With a view to counteracting "scale" distortion, a feature sometimes included is tone-compensated volume control. The volume control is arranged to introduce bass-boosting as it is moved towards the "Minimum" stop. It is founded on the assumption (which is often far from justified) that the amount of compensation required depends on the setting of the volume control. But in the hands of a non-technical or lazy person it may on the average get nearer the mark than either nothing at all or the completely flexible tone control.

Tone control, then, is justified for a number of reasons; but the form it should take varies enormously according to the person who is to have it.

Variable selectivity is another of the things which, if worth doing at all, is worth doing well. And if it is done well it is certainly worth doing. Otherwise, one has to put up with very poor quality or much interference, or probably some of both. It is not at all easy to produce a selectivity control that does not cause the slightest change of tuning, volume or tone. Some change of tone is inevitable, but, as mentioned above, there should be means for getting the best tone for every adjustment of selectivity. Variable selectivity generally means one more knob; but there is such a thing as ASC. The only sort that appears to have reached practicality is the one depending on the strength of the signal being received. A weak signal causes the maximum selectivity to operate; a very strong signal is assumed to be free from interference, and the response is broadened out to include all the sidebands. The selectivity required is not always strictly proportional to the signal strength, and a more correct—but far more complicated—system is to use the actual interference to control the selectivity.

Manual Selectivity Control

My comments on variable selectivity of the non-automatic type were dated October 11th, 1935. General conclusion: it is a good thing, *if* properly carried out.

The value of the very familiar and wrongly named AVC has been called into question in *The Wireless World*.† Personally, I have nothing against AVC, and would not dream of doing without it, because in the Big Set we are now considering there is no reason why an extra valve should not be used to separate the AVC department from the detector department and thereby avoid the distortion that the common arrangement is liable to produce. By the way, the proper description is "automatic *amplification* (or *gain*) control," but "automatic volume control" seems to be too firmly entrenched to dislodge.

† "Is Automatic Volume Control Worth While?" May 22nd, 1937.

"QAVC" is perhaps not a perfect term either; "inter-channel noise suppression" is more accurate, but clumsy. One would think that a system for setting a limit, according to the prevalence of noise in the situation concerned, of signal strength below which the set is completely silent, so that inter-station noise and also all stations too weak to be reasonably free from noise are suppressed, would be very acceptable. But it is not. One reason may be that many "Q" systems are badly designed and cause distortion or other faults. But to my certain knowledge it is not really popular even when done properly. The reason appears to be that it is beyond the intelligence of the ordinary set-buyer, and even of the dealer who sells it. They find that weak stations are inaudible, and do not take the trouble to find out that there is a maximum-sensitivity switch position. It is a pity, because, as I explained some while ago (January 25th, 1937), a really selective and reliable "Q" system would render tuning foolproof. A receiver can be so designed as to yield only correctly tuned stations or complete silence. But the very people for whose lack of skill this system is intended are those who think the set is wrong and send it back.

Better Than Nothing

So there are other means of ensuring or at least encouraging correct tuning. Visual tuning is one that is very commonly fitted, even in cheap sets. Whether it is as commonly *used*, or is just put there because it looks pretty and helps to sell the set, I am unable to decide. It is unquestionably better than nothing, but, as we are thinking in terms of what can be done outside the narrowest financial limits, that may not be good enough. It requires of the knob-shy operator a certain co-ordination of eye and hand, which may be too much to expect. I would give him ATC—the system that automatically corrects slight errors in tuning. As emphasised in my page on that subject (November 27th, 1936), it is vital for an ATC system to be absolutely reliable. Otherwise, all stations may be automatically *mis*tuned, and the poor fool of an owner left entirely to his own senses cannot do worse than that. But if it is reliable there is no reason why even the most self-opinionated expert need scorn to have it.

There is some risk of ambiguity here, for the letters ATC,‡ standing for "automatic tuning control," may be, and actually are, used when speaking of one or other of those schemes for selecting a station by pressing a button or dialling for it like a telephone. As a matter of fact, ATC is often combined with selector tuning so as to throw on the latter only the responsibility for getting near the correct tuning point of the wanted station; the ATC then does the rest. One of the chief difficulties about systems for selecting pre-tuned circuits is to avoid slight changes of tuning due to temperature, humidity and age.

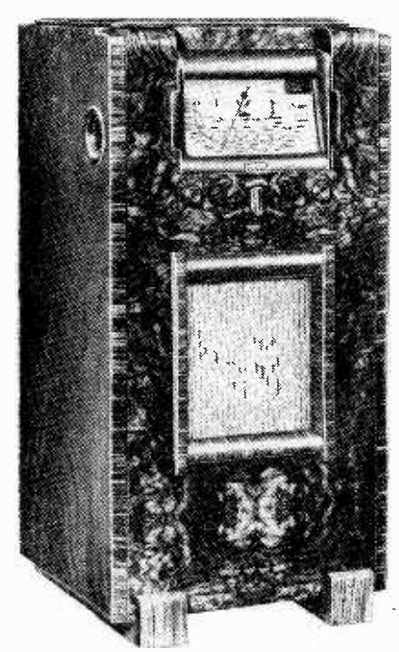
‡ To say nothing of their use for "Automatic Tone Compensation."

My own observation goes to show that a large proportion of set-owners, more especially those of the feminine gender, are not really happy with the conventional tuning knob, and would be much better suited by a selector system, but preferably something simpler than the telephone dial. I have felt for a long time that the most-needed tuning device is a simple switch plainly marked at one side "NATIONAL" and at the other "REGIONAL," so that either of these programmes can be instantly got by the least control-conscious listener. With the switch in the middle position the ordinary knob-tuning would be available for those that want it, and with the latter set to any approved station would provide the simple listener with a third choice.

You may draw your own conclusions from it about me; this is my ideal tuner, not only for the morons but for myself. Unfortunately, although it is a simple-sounding system, it is not very easy to apply to a receiver. It necessitates several pre-tuned circuits either made up of components of exceptional stability and permanence or else supplemented by the rather complicated ATC. But I am convinced that it is a worth-while feature and one that it might pay to develop, if sales-psychology does not upset it.

Cossor Model 598 Superhet Console

THIS receiver has been introduced to fill the gap in the "58" series between the table models and the radiogramophone. It incorporates the same chassis as that used in the Model 584 recently reviewed in this



journal, and is fitted, together with a 10-inch energised loud speaker, in a cabinet 36in. high, 17½in. wide, and 17¾in. deep. For AC mains operation the price is 16 guineas.

World Communications

THE CAIRO CONFERENCE AND SHORT-WAVE BROADCASTING

A WORLD wave-plan for short-wave broadcasting stations, ten kilocycle separation between stations, and more wavelengths for broadcasting are among the suggestions of the U.I.R. (International Broadcasting Union) for the World Communications Conference, which, organised by the International Telegraph Union, opens in Cairo on February 1st, 1938.

The Cairo Conference is a meeting of fully accredited government delegates and will discuss all types of world communication by wire and wireless telegraphy as well as telephony. The British listeners' representative will be Sir Noel Ashbridge, Chief Engineer of the B.B.C. He will be taking with him some other B.B.C. officials, among them, it is expected, will be Miss Isa Benzie, the Director of Foreign Services, in whose hands are the arrangements for all programmes from abroad.

In the eyes of the Conference and of many delegates, broadcasting is but a very small section of the matters to be dealt with. But the great public outside, the listening world, considers it all-important. Cairo will be a fight between the interests of the great body of listeners and the older claims of national and commercial services.

Little change can be expected on the medium-wave band. There may be a "little Cairo," like there was a "little Madrid" at Lucerne in 1933 to settle the European wave-plan, but it seems unlikely that broadcasting will be given more space in the medium-wave band.

The present short-wave chaos, however, may be submitted to an orderly plan. Recent statistics show that in October this year there were 242 short-wave broadcasting stations recorded by the U.I.R.'s checking post at Brussels; of these only 129 worked on wavelengths allotted to them under the Madrid Convention, whilst the remaining 113 operated on frequencies belonging to other services. According to Madrid, however, there are only 85 to 91 channels available in the short-wave bands for broadcasting.

The U.I.R. arranged a series of extensive, world-wide tests in the course of 1937 to gather material on the technical possibilities of a short-wave plan. Inter-Continental meetings were held at Paris in 1936 and Bucharest in June, 1937, to prepare these test series. The results will be at the disposal of governments and will help to uphold broadcasting's claim at the Cairo Conference, namely, that short-wave congestion is at present such that the whole system of short-wave broadcasting is in serious danger.

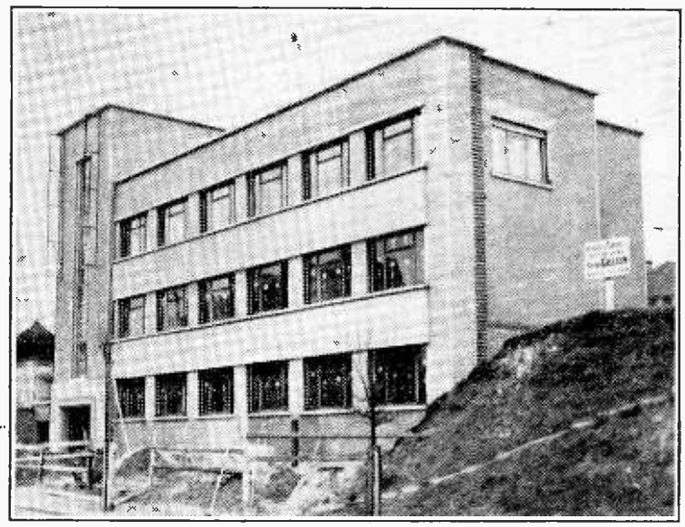
Shared Channels

The tests have proved that it will probably be impossible to arrange for stations in different parts of the world to share wavelengths, as even if they use highly directional aerials interference occurs. On the other hand, some countries may consent to work to a time-table, sharing a wavelength with another station and only working when the other is silent. The U.I.R. hopes to procure more channels between 50 and 200 metres for stations of local importance in tropical districts, thus clearing the bands below 50 metres for long-distance work.

Cairo, in view of short-wave activity, will have to break with the maxim laid down at Madrid that broadcasting is a national affair, and that all technical measures must be based on the national requirements of a country within its territory. This principle cannot alter the fact that broadcasting is international, and heeds no frontiers. Cairo, let us hope, will see things as they really are and make arrangements accordingly.

The Cairo Conference may take six weeks or it may continue for three months; the application of the results, however, cannot be expected before 1939 or 1940, so whatever the decisions and however revolutionary they may be, there will be plenty of time for listeners and the radio industry to prepare for the changes.

A. A. G.



TEN YEARS OLD. The International Broadcasting Union, which has just celebrated its tenth birthday, will be moving into its new home, here shown nearing completion, in Brussels early next year. This organisation directed by M. Raymond Braillard has grown from a small beginning in the garage adjoining the director's house.

DISTANT RECEPTION NOTES

READERS have probably been noticing for some little time the extraordinary strength with which the Swedish station Hörby has been coming in on 265.3 metres. For a month or so the station, when giving an afternoon programme, has been receivable at full loud-speaker strength some time before dusk. Darkness falls early, of course, in northern latitudes, but that hardly seemed to explain the amazing strength of a 10-kilowatt station.

In point of fact, though nothing was said about it, Hörby was pushed up to 100 kilowatts some time ago and it is now regularly using that output. It thus becomes Sweden's second station as regards power, for Stockholm is still rated at only 55 kilowatts.

Actually, 100 kilowatts is much in excess of the power permitted by the Lucerne Convention for a station using a wavelength of 265.3 metres. For stations between 240 and 272.7 metres a limit of 60 kilowatts was laid down and other stations, including Stagshaw, Nice, Lille P.T.T., and Rome No. 2, have been content to abide by this. Now that Hörby has opened the ball we may probably expect to find a good many other stations in the lower part of the medium-wave band putting up their power rating.

If you are looking for a new small American to capture here's one for you. WJBO, of Bâton Rouge, Louisiana, which used to have a 100-watt transmitter, has now a new plant working which is rated at 500 watts. It is giving special programmes for DX listeners on the first and fourth Sundays of each month between 2 and 4 a.m. Eastern Standard Time, which is five hours behind ours. As it will have the wavelength of 267.7 metres to itself it should be receivable under good conditions by early risers on these dark mornings. If you do pick up the station the chief engineer, Mr. W. T. Golson, will welcome reports.

At last Greece is to have something better than the little private Salonika station which has been in spasmodic operation for a long time. Radio-Athens, working on 499.2 metres, is expected to come into action on January 1st with a power output of 15 kilowatts. I am afraid it will be rather a tough nut for British DX-ers to crack since it shares the wavelength with Rabat and Sundsvall, rated at 25 and 10 kilowatts respectively. In adopting this wavelength Radio-Athens is taking what was given it under the Lucerne Plan, though, unless my memory is playing tricks, Greece was not one of the countries which signed on the dotted line. In 1933, when the Plan was formulated, Rabat had a power of only 6.5 kilowatts. Sundsvall, however, has not increased its power since then.

Have you noticed the unpleasant wobbly interference with Brussels No. 1 that is now in evidence? It is apparently caused by the 20-kilowatt Cairo, which transmits on the same wavelength. Those who worked out the Lucerne schedule were careful to allot shared wavelengths to stations separated geographically by great distances. They must have considered that the 20-kilowatt Cairo would not interfere with the 15-kilowatt Brussels No. 1. Perhaps it doesn't in the latter's service area, but the interference is pretty bad in this country.

D. EXER.

Random Radiations

By "DIALLIST"

Aching Fingers

IT'S a puzzle to me why some set manufacturers turn out receivers whose tuning knobs are so stiff to move. Try spending a while hunting for distant stations with such a set and you will have two complaints to make before you have been at it very long. The first is that the stiff knob makes your fingers ache; the second, that it is extraordinarily difficult—exasperatingly so—to make those minute movements that are frequently needed for fine tuning on the medium waves and still more frequently when it comes to the short waves. As often as not the stiffness is more apparent than real; the condenser spindle may be no tighter in its bearings than that of a set whose tuning knob turns quite easily. When the tuning does demand hard work from the fingers the trouble is not infrequently that the knob is too small to provide sufficient leverage. The big knob is always an advantage, even if the condenser doesn't naturally move stiffly, for its large diameter makes small movements so much easier.

If You're Going East

A CORRESPONDENT stationed in India sends me some hints which I pass on for the benefit of those who are going out to that country, and perhaps for those who are designing sets for the Indian market. India is rapidly becoming electrified, or at any rate large parts of it are, but there is much the same sort of mix-up with AC and DC as prevails with us. However, India has one boon which we haven't: the supply voltage, whether it be AC or DC, is standardised at 220. It's almost essential to acquire an AC/DC set if you are likely to be moving about at all. To give some instances: Delhi is half on AC and half on DC; so is Lahore; so is Ferozepore. New Delhi is all DC and Simla the same. Peshawar is mainly DC. The greater part of the North-West Frontier Province has DC, but there is a scheme afoot which may bring about a gradual change to AC in the course of from ten to twenty years. Another point of importance is that electric fans are used everywhere in the hot weather, and many of them are bad radiators of interference. Hence a well-screened set is desirable, and it is useful to have anti-interference aerial equipment and set-lead or mains disturbance suppressors.

A Sad Business

THIS business of marketing cheaper and cheaper dry HT batteries is a pretty sad thing. One knows how good the battery set can be nowadays if only it is given a chance. There are two things necessary if its performance is to be what it should. The first is that it must consume a fairish amount of high-tension current; the second, that that current should be supplied by a battery of adequate capacity. Advances in both circuit design and valve design have made it possible to turn out a battery superhet giving a very fair performance for a high-tension current consumption of ten milliamps or so. As one who has tested in the laboratory huge numbers of HTB's I can say with conviction that ten milliamperes is the utmost load that can be placed economically on a standard capacity battery of the highest quality. And quality makes a vast amount of difference to the performances of any battery—quality of the zinc cans, quality of the electrolyte paste, quality—this is specially important—of the manganese dioxide in the depolariser and quality of the insulation between cells. I know we shall be told that we needn't buy the four-and-ninepenny battery unless we want to, because higher grade batteries are available. But to the man in the street a battery is just a battery, and so long as it bears a good name he'll probably plump every time for the cheapest that comes to hand.

It Makes One Think

Have you ever considered that a 120-volt HTB must consist of eighty cells, each containing in its zinc can the paste electrolyte, the depolariser in its sac, the central carbon electrode with its brass cap and the seal of bitumen or some similar compound? Or that 158 soldered joints are required to connect these cells in series, to say nothing of a minimum of seven or eight sockets that must be soldered on to them to provide connections by means of wander plugs to positive, negative and the various tappings? Then each cell has to be provided with its own little compartment insulating it from the others, the battery of cells has to be housed in a cardboard case and the whole must be sealed off with bitumen or something of the kind. It would seem that there must be a considerable sacrifice of quality somewhere in order to make the new low prices possible.

The effects of using batteries not up to the work in hand are so serious that they ought to call for deep consideration by all concerned. To begin with, wireless reception, if you care at all about quality of reproduction or general performance, is nothing like what it should be. There is a continual deterioration in both quality and performance not only from day to day, but also from hour to hour. Next, using a battery set becomes a distinctly expensive business, for though cheap HTBs don't cost much to begin with, it isn't much fun if they have to be renewed at fairly frequent intervals. Thirdly, the battery set gets a totally undeserved reputation for being "heavy on HT" simply because the batteries used are not up to their work.

It Does Pay

If you want good reception with a battery set I am quite sure, after long experience, that you must use a high-tension battery of good quality and one that is easily able to cope with the load placed upon it. When I run sets from dry HTB's I work on two important factors. The first is that the battery should give at least six months' good service; the second, that the voltage drop during a four hours' run should not exceed about five per cent. I find that I can attain these desirable ends only by using batteries of high quality and of adequate capacity. Work on these lines and you will obtain really good reception with a battery set at no great annual expense. But if you go in for the cheap HTB *and* overwork it you needn't be surprised at heavy renewal bills and a rapid falling-off in performance.

A Fearful Example

NOT long ago there was in *The Wireless World* an article showing how bad are many of the aerials in use by listeners. You can't travel by car or train through any town or village without seeing a variety of extraordinary contraptions in use. One wonders how some of the owners of these ever hear anything at all on their receiving sets. The most awful aerial I have ever heard of is one described to me recently by a friend living in the depths of the country. He wrote first of all to say that he had bought a new set of good make whose performances I know from experience to be satisfactory in the ordinary way. He could get very little out of it, and complained bitterly of fading, noisiness and so on. I asked him to let me know what kind of aerial he was using, and here is what he reported, apparently quite unconscious that there was anything much amiss with his collector. At the house end it was fixed by means of a single midget insulator and a piece of wire to a gutter pipe,

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Vision 45 Mc/s. **Television Programmes** Sound 41.5 Mc/s.

THURSDAY, DECEMBER 16th.

3, "Tele-ho": a television revue written for Nelson Keys by his son John Paddy Carstairs. **3.20,** Gaumont-British News. **3.30,** "Prologue to King Lear"; a comedy by Ferenc Molnar adapted for television.

9, Evelyn Dall in songs. **9.5,** Experiments in Science No. 6—reconstructing the past. **9.20,** British Movietonews. **9.30,** "Genius at Home," by Elizabeth Drew.

FRIDAY, DECEMBER 17th.

3, Starlight: Dorothy Dickson and Ivor Novello. **3.20,** British Movietonews. **3.30,** The Matania Operatic Society in Act III of Verdi's "Aïda."

9, Ronald Frankau. **9.5,** Artists and their work—No. 3: Florentine paintings from the National Gallery. **9.20,** Gaumont-British News. **9.30,** "Prologue to King Lear."

SATURDAY, DECEMBER 18th.

3, The John Carr Jacquard Puppets. **3.10,** Cartoon film. **3.15,** Gardening: hints on orchid growing. **3.30,** "Genius at Home."

9, Variety. **9.20,** British Movietonews. **9.30,** Shakespeare's "Othello" with Diana Wynyard as Desdemona, and Ralph Richardson as Othello.

MONDAY, DECEMBER 20th.

3, A Selection of Christmas Toys for young and old. **3.10,** Gaumont-British News. **3.20,** "The Ghost Train," the thriller by Arnold Ridley.

9, Gillie Potter. **9.10,** Christmas Toys. **9.20,** British Movietonews. **9.30,** "The Old Lady Shows her Medals": a play by J. M. Barrie.

TUESDAY, DECEMBER 21st.

3, Music Makers: Irene Kohler (pianoforte). **3.10,** British Movietonews. **3.20,** 100% Broadway.

9, "Close-up"—a little show. **9.20,** Gaumont-British News. **9.30,** "Alice Through the Looking-Glass."

WEDNESDAY, DECEMBER 22nd.

3, A Little Show. **3.20,** Gaumont-British News. **3.30,** 105th edition of Picture Page.

9, A Little Show. **9.20,** British Movietonews. **9.30,** 106th edition of Picture Page.

the point of attachment being 16ft. above the ground and almost the same distance below the top of the roof. The lead-in and horizontal portion were in two pieces, there being a twisted joint between them. The horizontal part of the aerial ran immediately above a galvanised iron fence six feet high and its far end was stapled without any insulator at all to a point half-way up the sloping roof of the garage. The height above ground at the far end was about ten feet. I suppose there must be other aerials as bad—I can't imagine one much worse—here and there, and other people who blame perfectly good receiving sets because they can't perform the impossible

An Aerial on Wheels

INNOVATION BY PCJ

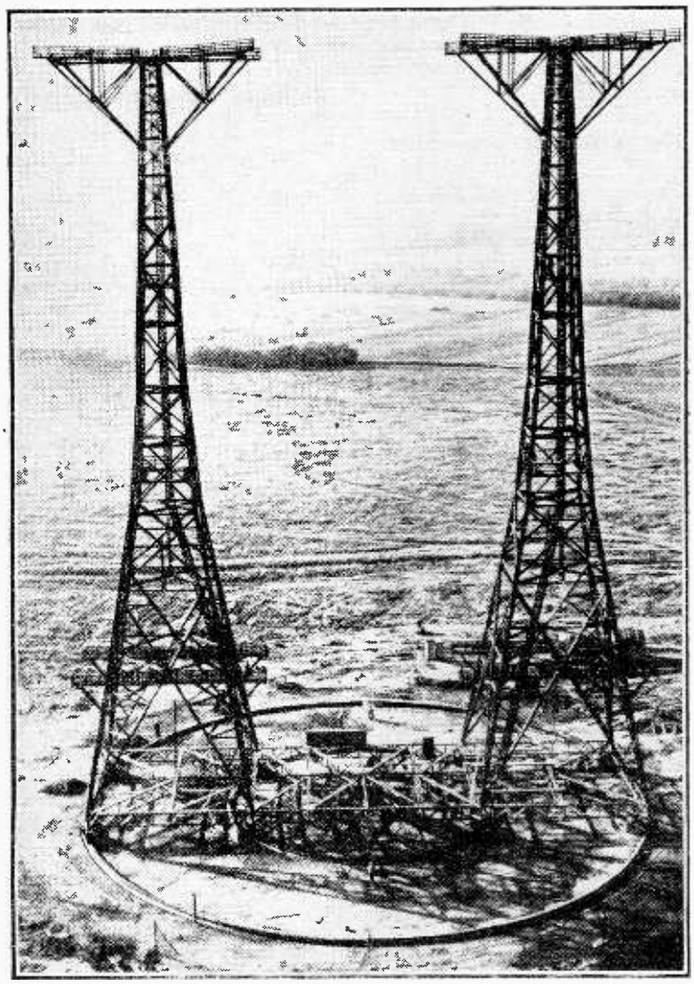
ONE of the most interesting experiments ever undertaken in short-wave transmission is now nearing completion at PCJ, the Philips short-wave transmitter at Huizen in Holland.

Recently it raised its power to 60 kW, and its next step is to overcome in a novel manner the one big disadvantage of directional short-wave—that of requiring a separate set of masts and aerials for each direction of the beam.

The scheme, which has been worked out in the Philips laboratories, is nothing less than a revolving aerial system on a much bigger scale than has hitherto been adopted. Here are some details of its construction.

Briefly, the new aerial comprises two wooden lattice masts, 165 feet high, which rest on a massive steel girder bridge mounted on a centre pivot and eight heavy wheel trucks. The whole system turns on a circular steel track, the circle of the outer rail being 145 feet in diameter, and the inner circle about 40 feet. The massive centre pivot is carried by a solid block of some 25 cubic yards of concrete. The weight of each mast is 18 tons, and that of the steel bridge on which they rest is 95 tons.

Thanks to the careful design of this unique aerial system, it can be revolved in any desired direction, either by electric motor or hand winch, and a somewhat amusing feature is a number of signposts around the circular track, bearing such indications as "Africa," "Argentina," "Brazil," and so on.



Revolving device for the short-wave antenna system of the Philips PCJ station.

Careful allowance had to be made for wind pressure, which in normal conditions is of the order of 4½ tons on each limb, but during storms may rise to as high a figure as 48 tons. Each of the eight wheel-bogies is therefore provided with heavy steel claws, which can be screwed up tightly on to the rails when the necessity arises.

The aerial system proper consists of 12 vertical di-pole aerials on each mast—24 in all, each aerial being fed separately. With an input of 60 kW, the effect of the special construction of the system is that the energy radiated in the direction of the beam is 24 times that of the radiation of an ordinary di-pole aerial, or, in other words, equivalent to the radiation from a di-pole aerial of a 2,000 kW transmitter.

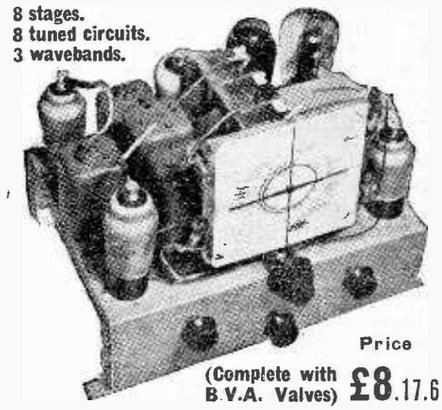
For the time being, this new aerial system will be used only on the 31-metre band, but if it proves as successful as is expected it is probable that an identical system will be constructed for other wave-bands.

Rotating Beam transmitters have been used in the past in the Marconi system, but not, we believe, with masts of anything like the height used in the arrangement at PCJ.

McCARTHY

6-valve all-wave Superhet with Radio Frequency Stage

8 stages.
8 tuned circuits.
3 wavebands.

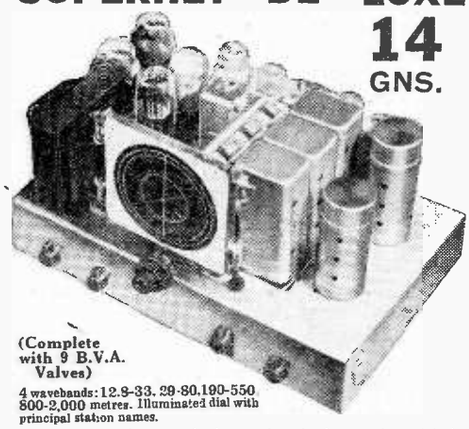


Price (Complete with B.V.A. Valves) £8.17.6

Performance (made possible by use of multi-electrode valves) equal to that of many receivers employing 8 valves or more. Brief specification includes: Large "Airplane" dial, with different coloured lights automatically switched on for each wave-range. Micro-vernier 2-speed drive. 4-point wave-change and gramophone switch. Volume control and variable tone control also operative on gramophone. Reinforced heavy-gauge steel chassis. Covers 19-2,000 metres.
Circuit comprises: Preselector circuit, radio frequency amplifier (operative on all 3 wavebands), triode-hexode frequency changer, double band-pass I.F.T. coupled I.F. amplifier, double diode-triode detector and L.F. amplifier. D.A.V.C. applied to 3 preceding valves. 3-watt pentode output.

9 VALVE FOUR-WAVE SUPERHET DE LUXE

14 GNS.



(Complete with 9 B.V.A. Valves)

4 wavebands: 12.8-33. 29-80.190-550 800-2,000 metres. Illuminated dial with principal station names.

Controls.—A feature of the receiver is the number of independent controls fitted, making it extremely interesting to operate. These include sensitivity control (varying bias on R/F stage), or Q.A.V.C. with manual muting control for inter-station noise suppression. 5 position wave-change and gramophone switch. Progressive variable tone control operative on radio and gram.

Circuit in Brief.—Aerial input to pre-selector circuit, radio frequency amplifier, latest type triode-hexode frequency changer, 2 band-pass I.F.T. coupled I.F. amplifiers, double diode detector, triode L.F. amplifier, separate triode phase-changer capacity coupled to 2 large pentodes in push-pull. Heavy 16-gauge steel chassis. Finest components and workmanship throughout. Harries tetrodes in place of output pentodes if desired.

STANDARD MODEL 12 GNS. As above, but with triode push-pull output, and fewer controls fitted

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CURRENT TOPICS

EVENTS OF THE WEEK IN BRIEF REVIEW

New Finnish Station

THE 10-kW station at Vasa, which works on a wavelength of 211.3 metres, has been fitted with a new type of "umbrella" aerial. Owing to the special design of this aerial system it is anticipated that its range will greatly exceed that of other stations of equal power.

Italian Activities

TWO new short-wave transmitters have been opened at Prato Smeraldo, the Italian short-wave centre. They are working on a wavelength of 19.78 and 19.61 metres, and usually relay the Rome No. 1 programme. At present transmissions are purely experimental and there is no regular time of transmission. Two new medium-wave transmitters are being built at Catania and Ancona.

Large Screen Television

DEMONSTRATIONS such as have been given here for some time in which the televised image is projected from the end of a comparatively small cathode-ray tube on to a cinema screen have recently been given in New York by the R.C.A. The screen used was 4ft. square. Another demonstration given was of a projection system designed for the use of a group of persons such as might be found in the average home, producing an image of 18 x 24in.

Ultra-Short-Wave Broadcasting

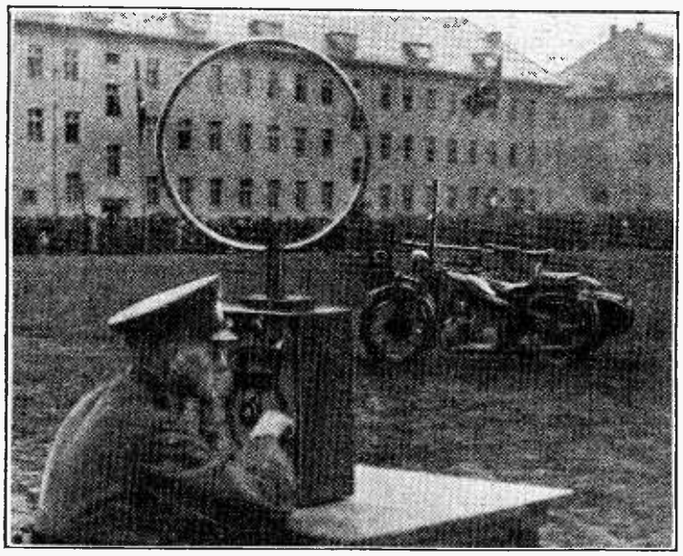
IT is well known that by using ultra-short waves it is possible to transmit programmes of considerably better quality than is the case when using more normal wavelengths. This is due to the much greater bandwidth which is available. *The Wireless World* has, in fact, frequently urged the B.B.C. to transmit programmes on these wavelengths, and it is interesting to learn, therefore, that the Italian broadcasting authorities have started such a service. Ultra-short-wave broadcasting was inaugurated on December 2nd by the opening of a station at Monte Mario, near Rome. The wavelength used is 6.9 metres, and at present the station is in operation from 6 p.m. to 9.30 p.m. (GMT) daily. Although the normal range of the station will be extremely restricted, as in the case of the Alexandra Palace, it is not at all unlikely that good reception may at times be had in this country when freak conditions abound.

Another Wireless Triumph

THE police radio service established at Newark (N.J.) three years ago has been an unqualified success, according to a report just issued. During the period mentioned it has been responsible for over 6,000 arrests and for the quick recovery of 1,600 stolen cars.

Seasonal Greeting by Wireless

CHRISTMAS and New Year Wishes of a length not exceeding ten words can be sent to anywhere in the British Empire for 3s., via the Communications network established by Cable and Wireless, Ltd. This special rate will be in operation until Twelfth Night. Special cheap rates to other parts of the world are also available.



REMOTE CONTROL. Quite a sensation was caused at a German military demonstration recently when a motor-cycle combination without a driver was efficiently controlled by wireless from a distance.

Television for India

ACCORDING to Mr. N. A. Printer, the president of the Bombay Technical Institute, India, will have a tele vision service early next year, the first station being in Bombay. Mr. Printer is at present visiting England with the object of placing contracts for the necessary apparatus. Five students from the Bombay Institute have arrived to take a special course of training in television technique.

Schwarzsender

HITHERTO the penalty for installing or operating an unlicensed transmitter in Germany has been a heavy fine or imprisonment. Henceforth, however, imprisonment accompanied by hard labour, without the option of a fine, will be the penalty. The same penalty will apply to transmitters who use their apparatus in a manner contrary to the regulations. The name of Schwarzsender (Black Transmitter) is used to describe these people much in the same way as the word "Pirate" is used over here.

World Radio Convention

THE Institution of Radio Engineers (Australia) has organised a World Convention, to be held in Sydney from April 4th to the 14th next year during the final period of the Australian 150th anniversary celebrations.

Italy's Keep-fit Campaign

ONE of the speakers in a series of talks on medical subjects which is being broadcast from Italian stations is Dr. Aldo Castellani, well known for many years as a Harley Street specialist, who will speak on the subject of Tropical Medicine on December 28th. They are transmitted every Tuesday at 5.45 p.m. (GMT), and will continue until May.

Marconi's Birthday

THE Italian Government has decreed that henceforth April 25th, which was Marconi's birthday, shall be observed as a national holiday.

U.I.R. Meeting

THE session of the International Broadcasting Union, which was held recently at Nice, was mainly concerned with arranging the agenda for the next International Telecommunications Conference.

Radiotelepathy

FOLLOWING the example set by the B.B.C. some years ago, the N.B.C. is using its network every Sunday evening for telepathic experiments, which are being conducted on a nationwide scale.

Finland Helps Listeners

THE Finnish broadcasting authorities have decided to send out parties of engineers to investigate reception conditions in all parts of the country. The engineers are to give advice to listeners as to the most suitable type of receiver for use in any particular part of Finland.

Small Ads. at Christmas

WITH the approach of the Christmas holidays slight alterations are necessary in our printing arrangements. Miscellaneous advertisements intended for the issue of December 30th must be received not later than first post on Thursday, December 23rd.

Finland Subsidises School Receivers

EDUCATIONAL broadcasts were commenced three years ago in Finland, these being made possible by the generosity of nearly three thousand enthusiastic pedagogues who presented their home receivers to the schools. These sets are now on their last legs, but the Government has come to the rescue by agreeing to defray two-thirds of the cost of supplying new and up-to-date receiving equipment.

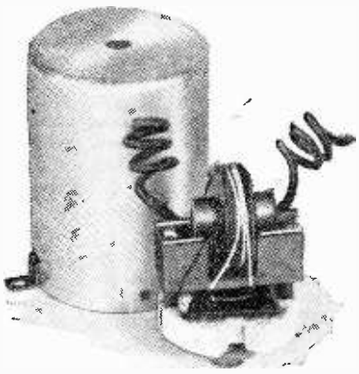
The number of Finnish listeners has increased by 27 per cent. during the past year, and now totals 208,358. The authorities are contemplating the erection of a new station near Helsinki, and, with this end in view, a temporary transmitter will commence operation in January to obtain certain technical data to assist in the choice of apparatus.

New Apparatus Reviewed

Recent Products of the Manufacturers

VARLEY I.F. FILTER

WITH an all-wave superheterodyne interference may sometimes be encountered from coastal and ship stations, as these work on wavelengths very near to that of the IF amplifier commonly used in such sets. As a rule this form of interference is only experienced on the coast, and it can be very troublesome indeed if by any mischance the IF amplifier is lined up



Varley 465 kc/s aerial circuit filter.

on a somewhat higher frequency than 465 kc/s, which would make the set particularly responsive to signals on about 600 metres.

In cases where the IF amplifier is correctly adjusted yet interference of this kind is troublesome, a remedy can usually be found by connecting a suitably designed filter in the aerial circuit.

The unit introduced by Varley, Bloomfield Road, Woolwich, London, S.E.18, for this purpose, and which is described as an IF filter, consists of a coil and a pre-set variable condenser joined in series. This is connected across the aerial and earth terminals of the set and tuned by its condenser to the intermediate frequency of the set.

If a particular station just slightly off this frequency persists in causing interference the filter could be used as a rejector for this one station and tuned accordingly.

The filter is assembled in a screening can measuring 1¾in. in diameter and 2½in. high. The adjusting screw for the condenser is on the top and two leads for connecting as described come through the open end at the base.

This filter should be mounted as close to the aerial and earth terminals as possible for it to be really effective.

It has the type No. BP121 and costs 4s. 3d.

MITCHAM MEASURING BRIDGE TYPE GM4140

WHILST the primary function of this bridge is the measurement of resistance and capacity, as it uses a Wheatstone bridge circuit and provision is made to totally disconnect the internal reference capacities and resistances, there is obviously quite a wide scope for it.

For example, two capacities or resistances alleged to be the same value may be joined to the three input terminals so that the centre one is common to both and the actual percentage difference, if any, between the two read directly from the scale. Inductances could be treated in the same manner.

The balance indicator embodied in the bridge is very sensitive, for it consists of a pentode valve amplifier and a CR type tuning indicator.

The adjustment for balance is critical, as it should be in an instrument that possesses a high order of accuracy. Tests made with several different resistances and capacities gave the same values on this bridge as on other high-grade measuring apparatus.

The order of accuracy is every bit as good as that of a laboratory instrument, yet it is a test set that by virtue of its simplicity of operation and versatility will appeal to the service engineer.

Resistances from 0.1 ohm to 10 megohms can be measured direct on this bridge by the four ranges provided, while the three capacity ranges enable measurements to be made from 10 m-mfds. to 10 mfds.

The bridge is AC-operated, and in addition to the two valves mentioned it contains a mains rectifier. Yet it is very compact, for the overall size is only 7in. by 5½in. by 5¼in.

Provision is made for checking the bridge without the need of external standards, though this must be carried out very carefully as the adjustment is extremely critical.

The bridge should not normally go out of adjustment and the need for checking will

AC mains operated resistance, capacity and general-purpose measuring bridge.

only arise if it be necessary to change the valves. To do this the knobs must be removed before the chassis can be withdrawn.

The workmanship and finish are outstandingly good. The makers are the Mullard Wireless Service Co., Ltd., 225, Tottenham Court Road, London, W.1, and the price is £12 12s.

Contrast Expansion Unit: A Correction

In the practical wiring plan of this unit, published last week, the positive and negative polarity signs on condenser C 10 were reversed. The *positive* terminal should be earthed.

Wireless Coils, Chokes and Transformers. By F. J. Camm. Pp. 176 and 126 diagrams. George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 2s. 6d. net.

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OUTSTANDING MERIT

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Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

Television

YOUR correspondent, Mr. T. J. E. Warburton, in his letter published in the issue of December 2nd, misses the truth in the confusion caused by his indignation with the radio critics.

Further reflection on his part would, I believe, have led to a conviction I hold. That in a few years all sound programmes will be televised. Or putting it better, future radio transmissions will always consist of sound and vision combined.

We shall accept the sound as a background, as, in the main, is done now. For those items that attract, then hold our attention, we shall find ourselves taking an interest in the visible proceedings.

I wholeheartedly admire the manner in which those responsible are tackling the extremely difficult task, especially with their limited resources, of furnishing pioneer vision programmes. But to be honest I believe that the failure of television to "catch on" is attributable to the lack of entertainment that these programmes provide.

And no wonder. Consider what they are trying to do. They are endeavouring to provide two hours entertainment, that is to hold our undivided attention, each day. The "Pictures" every night. Ugh!

But I am certain that Gerald Cock knows all this, and as soon as he is able to we shall have whole "Sound" programmes televised.

Whether we shall get on with our books and perpetrate that astonishing modern trick of concentrating while music roars into, or shall I say pervades, the room, or whether we shall watch and listen to the performers' efforts will depend on our personal likes and dislikes.

Actually, I believe Mr. Warburton thinks this, as is evidenced by the statement that is contained in his letter. "It can never by its nature attain the widespread popularity of sound broadcasting."

It might be assumed from the above that, if my remarks are correct, there is no real need for television.

The point is that "sound" reception conveys only a part illusion. Scenes will inevitably become part of the broadcasting of home entertainment for they are required to assist this illusion.

Adverting to the rest of Mr. Warburton's letter.

Are most people agreed that the screens are absurdly small? And did the magic lantern ever achieve popularity? I agree that the number of valves is high, but not "preposterously" so, surely.

Mr. Warburton must also concede that the cost of these valves will also settle itself concurrently with the settling of the receiver cost.

Whilst on the point. The recent *Wireless World* design was an improvement in this direction. But I do not consider it an important point if operating simplicity is adversely affected or if constructional difficulties are increased by securing the utmost from a reduced number of valves.

We have laboured long under this illusion for normal broadcast receiver design.

And Mr. Warburton's final remark that the installation of television sets can never be the simple matter that is the case with "sound" receivers. Why?

Ipswich. S. WEST.

Film and Disc

THE method of synchronising film with disc, described by Mr. Aldous in his letter included in your issue of November 25th, appears to be similar in basic principle to the very successful one used by the Paillard-Bolex Company on their sound-on-disc machine first marketed somewhere about 1932. I have had one of the Paillard machines in use for some four years and have had no trouble, synchronism is maintained perfectly throughout 400 feet of 16 mm. film coupled with standard 16-inch disc running at 33⅓ r.p.m.

In the Paillard system projector and turntable are linked by means of a spindle projecting from each, one spindle carries a loose collar with a female thread into which the other spindle screws. If the two machines run in sychronism the two spindles rotate at the same speed and the collar rotates but does not move laterally; suppose, however, that the projector slows down, no strain whatever is thrown on the turntable (beyond the entirely negligible friction of the screw), but the collar unscrews and would eventually fall off. In sliding along to fall off it closes a pair of contacts, which short-circuit a resistance in the projector motor circuit, thus speeding up the projector once more into synchronism. The projector therefore is continually "hunting" the turntable, in practice this "hunt" is so small and rapid as to be quite unnoticeable. Slight asynchronism may be corrected while the machines are running by adjustment of the contacts.

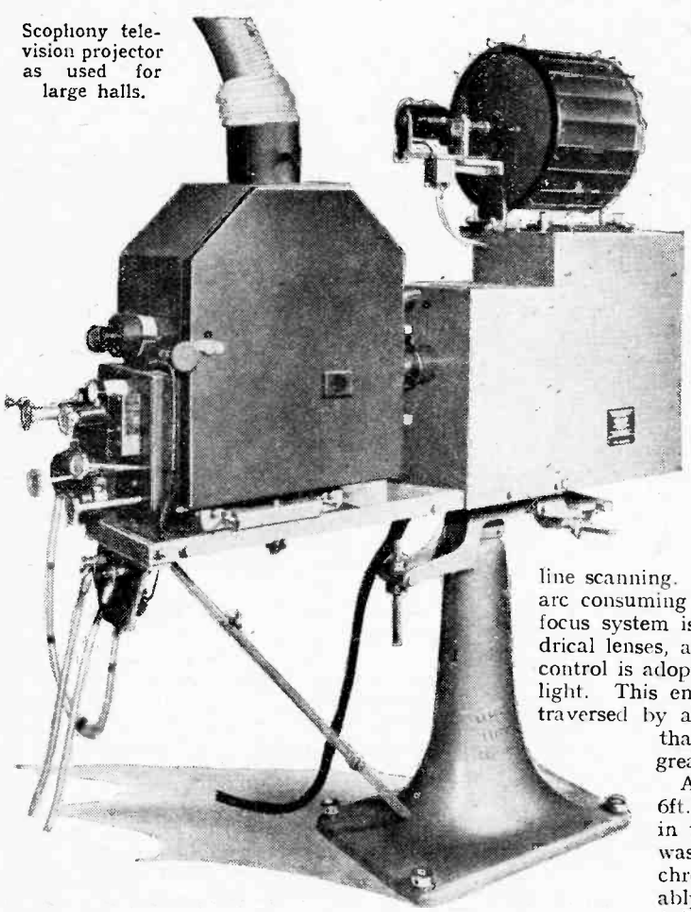
It will be seen that the system fulfils the essential requirement that variation in the projector speed shall not be communicated to the turntable. Slight variations in projector speed are of no consequence so long as mean synchronism is maintained whereas variations in the speed of the turntable cannot be tolerated.

May I express the opinion that S.O.D. (sound on disc) has much to recommend it to the amateur using substandard film. One of the inherent defects of the S.O.F. (sound on film) system for substandard work with sound and picture on the same film is that the linear speed of the film past the sound-heat is insufficient for good quality. It will be remembered that when talkies arrived standard film (35 mm.) was speeded up to 24 frames per second chiefly on account of sound track; 16 mm. film, even when running at 24 frames, has a linear speed of less than half that of the standard equivalent. For this reason the use of separate films for sound and picture as described by Mr. Aldous has considerable promise for substandard work. There can be little doubt that S.O.F. will eventually oust S.O.D. in sub-standard work as it has in standard film production. C. H. CAMPBELL GRAY.

Large Screen Television

5ft. by 6ft. Pictures

TWO demonstrations of large screen television took place recently. The first was given at a Bromley cinema by the Baird Company, and a projection-type cathode-ray tube was employed. It is understood that this operates at 25,000 volts. A small, intensely brilliant picture is obtained on the end of the tube and is projected by a lens system on to a screen.



Scophony television projector as used for large halls.

Although not yet demonstrated, Baird have announced further progress in the development of colour television.

The second demonstration was by Scophony, Ltd. A mechanical system was employed with two mirror drums, one revolving at a fairly slow speed for the frame scanning, and the other at 30,375 r.p.m. for the line scanning. The light source is an arc consuming some 6 kW. A split focus system is employed with cylindrical lenses, and the supersonic light control is adopted for modulating the light. This enables the screen to be traversed by a line of light rather than a spot, and gives a great increase in brilliancy.

A picture about 5ft. by 6ft. was obtained. Viewed in the dark the brilliancy was adequate and the synchronising held remarkably well. The results obtained were, in fact, a considerable achievement and showed clearly that the reception of high-definition television does not necessarily involve the use of the cathode-ray methods that are now in such general use.

On the Short Waves

NOTES FROM A LISTENER'S LOG

SOMETHING has just happened to me which no doubt has also happened to many readers of *The Wireless World* at some time or other; to be brief, I have moved from an AC area to a DC one, to Epsom in fact.

From many standpoints it was, of course, essential that an all-wave receiver should be put into commission as soon as possible, so a temporary "L" aerial was erected from the gutter above a bedroom window to a post at the end of the garden, making the aerial more like one half of an inverted "V" than the intended "L."

Experience has shown that sloping wire aerials are quite efficient on the short waves.

Having erected the aerial, a rotary converter was connected up and an H.M.V. model 650 which was kindly loaned was put into service.

Unfortunately, short wave reception of the standard to which I had become accustomed proved to be impossible, the interference generated by the rotary converter drowning all signals of a lower level than about 100 micro-volts per metre, and this includes quite a lot of worth-while signals.

Needless to say, the converter as installed was equipped with suppression devices both in the DC and AC circuits, but even the addition of extra 0.01 mfd. condensers directly across the DC bushes (centre point earthed) did not materially reduce the interference. It is now believed that a great deal of the interference travels from the AC side of the converter to the receiver, and not, as is often thought, radiated from the DC mains to the aerial.

The next step was to procure a DC mains receiver, and a 7-valve Midwest was obtained which had been modernised and converted to DC use (230 volts), the valve arrangement being RF stage 6D6, OSC., 6D6 (as triode), mixer 6A7 (as hexode), I.F., 6D6, DD/Triode 75. RC coupled to the output valve, a Marconi N30, with negative feed-back from the speech-coil of the Rola G6 to the cathode of the 75. The cathode of the 75 in this set is normally taken direct to earth, the grid being directly coupled to the diode circuit. Fifty per cent. of the volts developed across the 3-ohm speech-coil are fed-back.

This particular receiver tunes continuously from 9 to 2,400 metres and has given quite satisfactory results. Strangely enough, with this receiver the noise level on the short waves is very low although the sensitivity of the receiver is adequate to bring in W2XE at full loud speaker strength in the afternoon on 21.52 Mc/s.

On the medium- and particularly on the long-wave band, however, the noise (mains-borne) is quite high and sufficient to spoil reception of Droitwich unless the positive mains lead was earthed, via a 2-mfds. condenser (fortunately the negative wire is earthed) and a smoothing choke carrying the total load of the receiver inserted before this condenser.

I am now converting my main receiver to DC, and in doing so begin to fully appreciate the flexibility of the U.S. 6.3v 0.3 amp. type valve, since it is very easy to convert the wiring of the heaters from parallel to series operation and generally the only valve that need be changed is the output pentode.

Actually the new arrangement will be:—RF stages 2-6D6's, osc., 6C5 (octal), mixer, 6L7 (octal), I.F., 6D6 (six tuned circuits), DD/Pentode 6B7 or DD/Triode DH30, and output 2-KT31 tetrodes with negative feed-back, parallel operation class A.

The ease with which two types of U.S. valves and the English DC/AC range may be mixed is worth noting.

The next step is to redesign my television set for DC operation, since although the television sound comes through without much noise when running from the rotary-converter, the picture is more badly affected, the field strength of Alexandra Palace in my particular part of Epsom not being too high.

The transmitting equipment presents another problem, but by way of compensation my house is situated at the end of a cul-de-sac, so that car-ignition interference is mercifully low.

Owing to a very noticeable decline in sun-spot activity almost to sun-spot minimum conditions, short-wave reception has been poor and especially so during the last week in November.

Observant listeners will have noticed during that week that even the B.B.C. relays from the U.S. were quite poor, the first few minutes of "Broadway Matinée" from the Columbia System on Monday, November 29th, having been taken over the G.P.O. long-wave circuit; on one day last week only a single very small sun-spot was seen.

A study of previous eleven-year cycles indicates that the dips of low activity during the maximum years are likely to last over 3 solar rotations, or approximately 2½ months, so that we should not expect a marked improvement in night-time reception on 11 and 9 Mc/s until some time in February, which is always a month of high activity.

During the day-time conditions have been more normal and it would appear that the violent fluctuations in visible sun-spot activity are very much smoothed out in their daylight effects.

Reception of W2XE on 11.83 Mc/s has recently been good from 8 p.m. until 10 or 11 p.m. and both W1XK and W2XAF in the 9 Mc/s band have given good results, but the strongest and most consistent transmitter still is W2XE in the afternoons on 21.52 Mc/s, with W2XAD good at 6-7 p.m.

Later at night, around 10 or 11 p.m., the 49 metre band comes into its own, and some of the occupiers may now be received quite well. The interference from the S. American stations seemed to have diminished a little with the removal of many of them to frequencies nearer to 7 or 5 Mc/s.

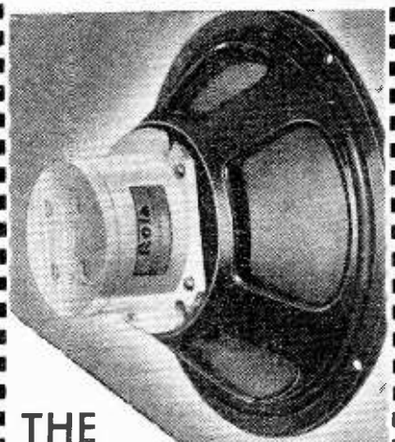
ETHACOMBER.

MAZDA VALVES

WE are informed that the filament current rating of the L.21/DD valve has now been reduced from 0.15 amp. to 0.1, and that the T.21 Thyratron is now rated for a maximum output of 120 volts.

Stocks of certain obsolete valves are now completely exhausted, and no further supplies will be available. These valves are: S.215B, Pen 425, P.625A, P.625B, PP3/425, U.65/550, DC/HL.

POINTS OF IMPORTANCE in the Rola G.12



THE TROY POUND

As long ago as 1758 a standard of weight, the Troy Pound, was constructed by order of Parliament and lodged with the Clerk of the House of Commons. The Troy Pound was lost when the Houses of Parliament were destroyed by fire in 1834 but a fresh standard took its place for always there must be some measure of weight by which others are judged. So with loudspeakers, the connoisseur instinctively takes the best producer he knows as a standard upon which to base his judgments.

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G.12 P.M. (as illustrated) less Transformer	£4 16 0
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G.12 D.C. Stripped, but with Transformer	£4 4 0
G.12 D.C. Stripped and without Transformer	£3 15 0

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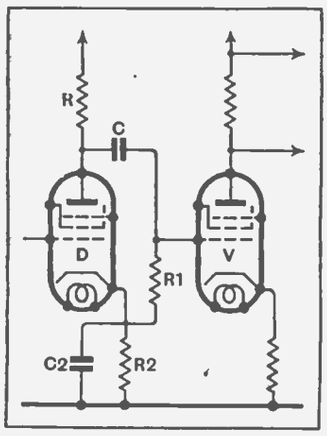
Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section

TELEVISION AMPLIFIERS

FOR accurate picture reproduction in television, it is necessary to control the average light-intensity on the receiving-screen in accordance with the slow changes that occur in the average background illumination of the scene at the transmitter. This means that the receiver must be able to amplify what is practically a direct - current component or "zero" frequency.

The circuit shown in the drawing is designed to handle a wide band of television signals, ranging down to zero. The higher frequencies from the detector valve D are fed to the amplifier V through a resistance-capacity coupling R, C. The grid circuit of the amplifier is completed through a resistance R1 and a resistance R2 included in the anode-cathode circuit of the detector D. The lower frequencies, down to zero, are developed across the cathode resistance R2, which is shunted by a condenser C2 to bypass the higher frequencies, and



Detector and amplifier circuit of receiver designed to handle modulation frequencies down to zero.

is directly coupled to the grid of the amplifier.

The British Thomson-Houston Co., Ltd. and J. Moir. Application date January 31st, 1936. No. 469813.

o o o o

PROJECTION SYSTEMS

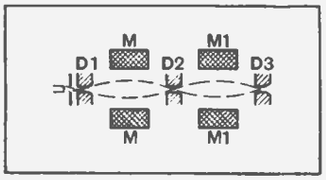
IN order to overcome the limitation upon the size of the received picture imposed by the use of the ordinary fluorescent screen, the latter is replaced by a light-valve consisting of a colloidal suspension of quinine - sulphate crystals. Under the influence of the electron stream from a cathode-ray tube, the crystals are orientated in a definite way so that they pass light rays from a lamp on to an external viewing-screen in accordance with the varying intensity of the incoming signals. In this way the received picture is projected on to an external screen, the size of which is not limited by the dimensions of the cathode-ray tube.

Baird Television, Ltd., and J. L. Baird. Application date February 13th, 1936. No. 470347.

o o o o

SECONDARY-EMISSION AMPLIFIERS

IN a cathode-ray television receiver, both the intensity and the magnitude of the electron



Electron magnifier for embodying in CR tube.

stream are increased by passing it through a series of perforated discs D1, D2, D3, the walls of which are coated with emissive material, such as caesium. The path of the stream is controlled in its passage from disc to disc by external magnetic focusing-coils M, M1. At each impact, secondary emission occurs from the discs, so that an amplified stream passes on towards the fluorescent screen, as indicated by the dotted lines.

Marconi's Wireless Telegraph Co., Ltd., and N. Levin. Application date February 3rd, 1936. No. 469897.

o o o o

"STATIC" SUPPRESSORS

THE high - voltage discharge lamps used for advertising and display signs may be troublesome sources of radio interference. As a remedy, it has already been proposed to insert a series choke coil. of the order of 50 Henries, in the leads between the secondary of the supply transformer and the electrodes of the lamp.

According to the invention, equally good results can be secured by using a much smaller and cheaper inductance, say, a coil of between 1 and 10 Henries, provided it is shunted by a high-resistance of the order of 200,000 ohms.

The theory is that the shunt resistance serves to damp out oscillations created in the tuned circuit formed (a) by the capacity across the secondary windings of the supply transformer and (b) by the inductance of the choke. Unless suppresed, these oscillations are said to form the principal source of "static" interference.

The General Electric Co., Ltd.; N. R. Bligh; and H. G. Lillicrap. Application date June 19th, 1936. No. 470301.

WIRED WIRELESS

RELATES to systems for distributing broadcast programmes over existing wire networks, such as an ordinary telephone system or a power-supply line. By using carrier frequency currents, the subscriber to such a system is able to select any desired one of a number of different programmes.

But the problem arises of providing as uniform a distribution of signal strength as possible to receivers on every branch of the system, in spite of the existing transformer-couplings between the main supply line and its various feeders.

According to the invention, the ratio of the transformers is so chosen that the primary windings present to the main feeder an impedance which is several times larger than its surge impedance, thus avoiding serious reflection losses at each junction. The degree of out-of-balance matching is reduced for the more remote feeders.

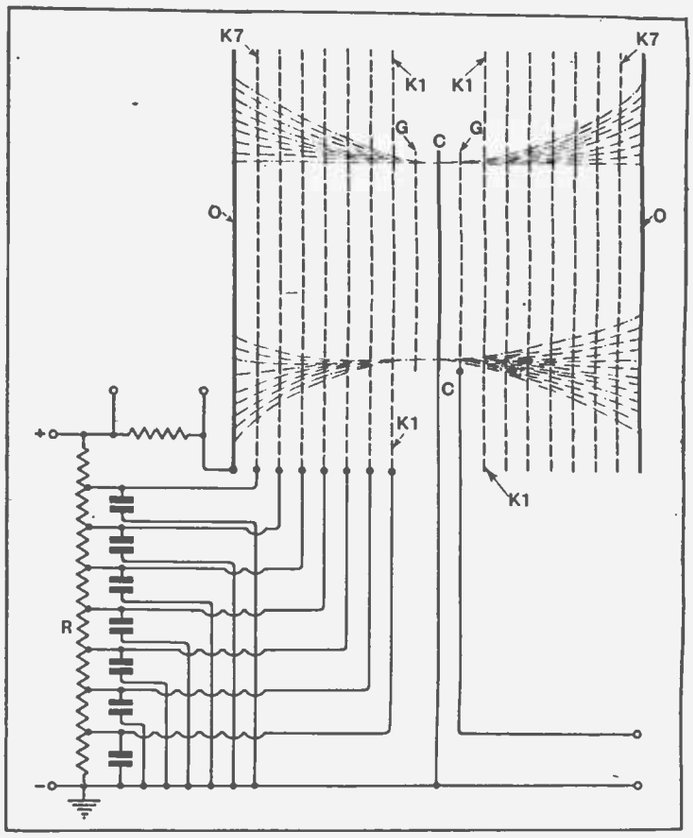
R. E. H. Carpenter and P. P. Eckersley. Application date March 25th, 1936. No. 470286.

o o o o

To avoid these difficulties the cathode C is surrounded first by an open-mesh grid G, and then by a series of secondary-emission electrodes K1 - - - K7, made of silver or silver-plated copper, oxidised and sensitised with the vapour of caesium, rabidium or alkaline metals.

The emission electrodes are of fine mesh, running to about 200 or more to the inch, and the biasing voltages for them are supplied from a potentiometer R which is graded from 300 to 1,000 volts.

The arrangement is stated to give high amplification without requiring the use of electron focusing devices, and without generating excessive heat. The dotted lines in the Figure illustrate the progressive amplification, due to secondary emission from the various electrodes interposed between the cathode C and output electrode O.



Construction details of electron multiplier fitted with concentric electrodes.

ELECTRON MULTIPLIERS

WHEN using an amplifier of the electron-multiplier type, difficulties arise, partly owing to the intermingling of the primary and secondary electron streams and partly owing to the tendency of the amplifier to produce excessive heat

Marconi's Wireless Telegraph Co., Ltd., and L. M. Myers. Application date February 8th, 1936. No. 470102.

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each. A selection of patents issued in U.S.A. is also included.

The Wireless World
THE PRACTICAL RADIO JOURNAL
27th Year of Publication

No. 956. THURSDAY, DECEMBER 23RD, 1937. VOL. XLI. No. 26.

Proprietors: ILIFFE & SONS LTD.

Editor:
HUGH S. POCOCK.

Editorial,
Advertising and Publishing Offices:
DORSET HOUSE, STAMFORD STREET,
LONDON, S.E.1.

Telephone: Waterloo 3333 (50 lines).
Telegrams: "Ethaworld, Sedist, London."

COVENTRY: Hertford Street.
Telegrams: "Autocar, Coventry." Telephone: 5210 Coventry.

BIRMINGHAM:
Guildhall Buildings, Navigation Street, 2.
Telegrams: "Autopress, Birmingham." Telephone: 2971 Midland (4 lines).

MANCHESTER: 260, Deansgate, 3.
Telegrams: "Iliffe, Manchester." Telephone: Blackfriars 4412 (4 lines).

GLASGOW: 26B, Renfield Street, C.2.
Telegrams: "Iliffe, Glasgow." Telephone: Central 4857.

PUBLISHED WEEKLY. ENTERED AS SECOND CLASS MATTER AT NEW YORK, N.Y.

Subscription Rates:
Home, £1 1s. 8d.; Canada, £1 1s. 8d.; other countries, £1 3s. 10d. per annum.

As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

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EDITORIAL COMMENT

Our Questionnaire

What Readers Want

SINCE the publication of a Questionnaire in our issue of October 1st we have been busily occupied in analysing the results and profiting by them.

We would wish, once more, to thank our readers, as we have already done on one or two occasions since the Questionnaire appeared, for the response which we received to the invitation. Approximately one reader in every five filled in the form and replies have reached us from every corner of the globe and are even now continuing to arrive from remote parts. It need hardly be said that this big response is most gratifying to the editorial staff, more especially when an analysis of the forms indicates emphatically that the general policy of the paper meets with the approval of present readers and that comparatively little change in policy is desired.

Invaluable Help

We have been very much impressed with the painstaking way in which the form, in spite of its many questions, has been filled up, and with the fact that in no single case has advantage been taken of the absence of names and addresses of readers to abuse the opportunity, but rather every individual reply seems to have been prepared with a conscientious desire to be as helpful as possible. The enormous number of compliments paid to the paper would be enough to bring blushes to the cheeks of even the most insensitive editorial staff.

And we would like to assure readers that the editorial staff is not insensitive but is an enthusiastic team anxious to profit by every reader's suggestion to enhance the reputation and usefulness of *The Wireless World*.

A careful analysis of the Questionnaires has revealed fairly strong preferences for certain types of articles, and it will therefore be our intention, as a gradual process, to endeavour to increase the proportion of such material, as one means of responding to the personal preferences shown by our readers.

As one of the "by request" features we are arranging for a special series of articles intended to explain in every detail how circuits function and the reasons for the choice of every component value. This series of articles discussing theory will be illustrated in practical form by giving complete information for the construction of the receivers discussed.

Technical News Service

Another direction in which an improvement will be made will be in strengthening the technical news side of the paper whilst less attention will be given to programme details and other matter of a more general nature.

We would like our readers to feel that our Questionnaire was no isolated invitation to them to express their views regarding the paper but that we should value their further opinions at any time. Suggestions from readers are always most welcome, for not only do they provide evidence of the interest but they are most helpful to the editorial staff.

Interest in *The Wireless World* continues to grow and we hope that the issues in the coming year, influenced to some extent in their contents by the gratifying response to our Questionnaire, will appeal more than ever to our present and to many additional readers throughout 1938.

The Wireless World

Push-Pull Quality Amplifier

INCREASING THE POWER OUTPUT

By W. T. COCKING

BECAUSE of the great popularity of the Push-Pull Quality Amplifier details are given in this article of the alterations necessary to take advantage of the increased rating of the PX4 valve. It should be noted that no one is obliged to modify the amplifier when re-valving; the change need only be made if increased output is wanted

THE recent alteration in the rating of the PX4 valve has resulted in many requests from users of The Push-Pull Quality Amplifier for details of the alterations necessary to obtain the increased output of which the valve is now capable. In the first place, it may be said that there is no change in the valve itself; the change is only in the maximum anode voltage rating. Consequently those who find that the present output of their amplifiers is sufficient need make no alteration whatever when renewing valves; they will still obtain the same performance.

There are, however, many who do want a greater output than the 4-6 watts of which the amplifier is normally capable, and are attracted by the prospect of obtaining some 7-9 watts from the same valves. The method of modification to be adopted depends in large degree upon the receiver used with the amplifier and is by no means as straightforward as one might expect.

Under the conditions of operation normal to this amplifier the output stage requires 285 volts at 70 mA. for the anode and grid supplies; this current is less than the normal for the old rating because the valves were deliberately over-biased to a small degree to economise in anode current. With the new rating the stage requires 344 volts at 100 mA. and it is easy to see that the increase in voltage and current cannot readily be secured from the existing mains equipment.

The Operating Conditions

Let us first of all determine the precise operating conditions of the output stage. The existing bias resistances have values of 1,000 ohms, and they are sufficiently near the normal values to be employed with a negligible difference to the output. The anode current will be 45 mA. per valve, however. Allowing for the drop in the output transformer primary, the total voltage required is 360 volts at 90 mA. As the output stage will require a bigger signal input under the new conditions, the voltage on the valves in the penultimate stage must be increased so that they can provide this extra voltage without distortion. This can be done by feeding the stage from the same point as the output stage, 360 volts, and the two MHL4 valves then consume some 11 mA. The total current consumption of the four valves in the amplifier is thus 101 mA. at 360 volts.

Now the unsmoothed output of the mains transformer and rectifier is 120 mA. at 450 volts, and more current cannot be drawn without exceeding the rating of both components. The rectifier can, it is true, be changed for one of higher rating, but the limitation of the mains transformer still exists.

We thus have a surplus of only 19 mA. for the preceding equipment. This is ample for the case where a simple gramophone feeder unit only is used, but is inadequate for most of the receivers described for use with this amplifier since most of these consume about 40 mA. There is one exception, however; *The Wireless World* Straight Six consumes some 25 mA. only. If this is used with an amplifier taking 101 mA. the total is 126 mA. and the ratings of the rectifier and mains transformer would be exceeded by only 5 per cent.—and overload which they would probably withstand without harm.

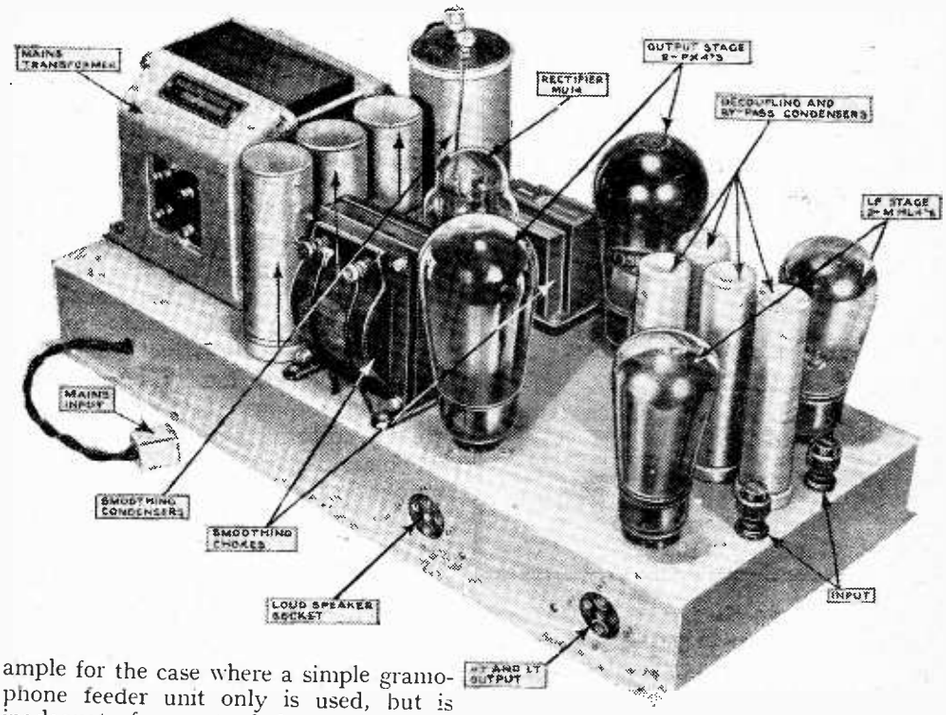
It will be clear that if a receiver drawing a large current is used the output cannot be increased without having to fit a new rectifier and mains transformer. The Straight Six or a gramophone feeder-unit can, however, be employed.

Let us consider this case now. The output of the rectifier is 450 volts and the output stage needs 360 volts; 90 volts must be dropped, therefore, at a current varying from 102 mA. to 126 mA. according to the particular associated equipment. This means a circuit resistance of 880 ohms to 715 ohms. Of this 215 ohms is supplied by the first smoothing choke, leaving 665 to 500 ohms for the remainder.

The Loud Speaker Field

The second stage of smoothing is normally a speaker field of 1,250 ohms resistance; 150 volts are dropped across it and 14.4 watts dissipated in it. This field is obviously of too high resistance to be used. The first thing that occurs to one is to shunt the field with a resistance to bring the total down to 500 ohms. This means a resistance of 830 ohms and the power in the field is only 3.2 watts, which is quite inadequate. The second thing to try is to have the field rewound to 500 ohms and pass the whole current through it. This gives a power in the field of 7.95 watts. This is much better, but the field excitation is still inadequate.

It is clear, therefore, that the field cannot be energised from the existing mains equipment. There is a certain power



A view of the original amplifier and its mains equipment.

Push-Pull Quality Amplifier—

available from this equipment which originally was nicely balanced between the output stage, the receiver, and the speaker field. If the output valves are operated under their new rating, however, their power consumption is increased and the balance is upset. The increase in power in the output stage, allowing for the bias supplies, etc., is 12 watts, but even more than the increase of power it is the change from the balanced condition which creates difficulties.

In actual fact, it is only those who are using the amplifier with a gramophone feeder-unit or the Straight Six and *who are not energising a speaker field from the mains unit* who can adopt the new rating for the PX4 valves without much additional expenditure. The alterations are then as follows:—

Case 1. Permanent magnet or separately energised speaker.

Single valve gramophone feeder unit.

Remove any bleeder resistance in the feeder unit. (R22 in the original feeder unit. May 11th and 18th, 1934.) Connect to the two points on the amplifier to which a speaker field is normally joined a resistance of 650 ohms of 10 watts rating. The smoothing will still be adequate in most cases, but if hum appears use a choke instead of the resistance; the choke should be 20 H. 120 mA. 650 ohms.

Case 2. Permanent magnet or separately energised speaker.

The Wireless World Straight Six.

Connect a 500-ohm resistance or 20 H. 120 mA 500-ohm choke as above.

Disconnect R7 and R8 from C9 and join them instead to C10, thus increasing the voltage on the penultimate stage.

Insert a resistance of 4,000 ohms 3 watts rating in series with Ch1.

The Amplifier with a Large Receiver

Those who are energising a speaker field from the mains equipment will have to provide a new mains transformer, rectifier, and higher voltage rating reservoir and smoothing condensers, or to provide a separate source of current for the field. The latter course is the simpler and cheaper, and the amplifier should be modified according to Case 1 or Case 2 above and the field energised in the way shown in Fig. 1. The choke and condenser shown dotted are not always necessary, but should be included if hum is found.

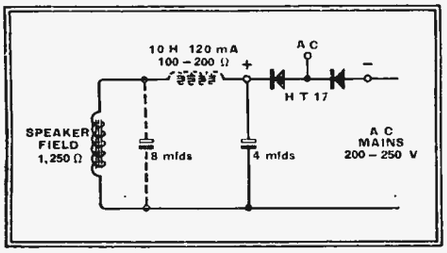


Fig. 1.—A loud speaker field can be energised in the manner shown here. The condensers should be rated for 400 volts working.

We have now to consider the case of those who are using a large receiver with the amplifier. There are two ways of operating it—the mains equipment can be redesigned for a larger output, or the modifications above can be adopted and a small separate mains unit can be provided for operating the receiver.

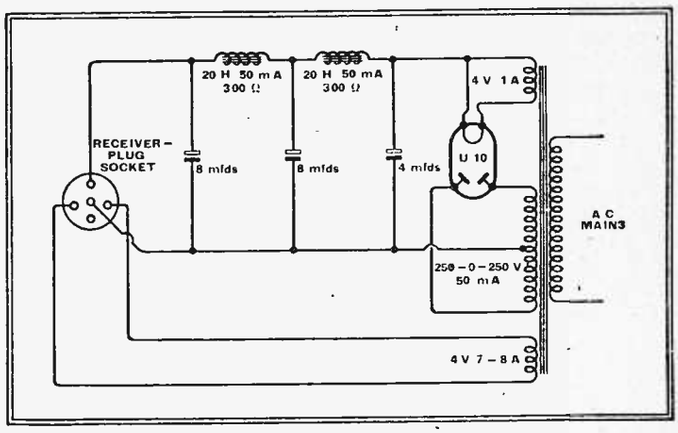


Fig. 2.—The circuit of a small mains unit suitable for supplying a receiver is given here. Condensers of not less than 400 volts rating must be used.

Let us consider these alternatives in order. We shall be wise to allow rather more than the 40 mA. which most receivers consume, so let us take the total current at the round figure of 150 mA. Allowing only for the single choke Ch2 of the amplifier for the output stage smoothing, therefore, the unsmoothed output must be 385 volts at 150 mA. The U18 rectifier is needed and the transformer must be rewound to have a rectifier filament secondary of 4 volts 3.75 amps. and an HT secondary of 350-0-350 volts at 150 mA. The speaker field should be energised separately. If it were energised from the mains unit it would have to be shunted by a 5,000-ohms 5-watt resistance and the rectifier output would have to be 535 volts. This would mean an HT secondary of about 475-0-475 volts, and the reservoir condenser would have to be replaced by one of 700 volts rating and the first smoothing condenser C11 by one of at least 600 volts rating.

Now if we use a separate mains unit for the receiver we are involved only in the alterations to the amplifier described under Cases 1 and 2. The speaker field will still have to be energised separately for its current and voltage requirements are not such as to fit in nicely with a small mains unit for working the receiver. The output of this unit need be only 250 volts at 50 mA. and is easily obtained from the arrangement of Fig. 2. This unit can be quite inexpensive for all the condensers can be electrolytic, and it will give an output of about 240 volts at 50 mA., rising to some 280 volts at 30 mA. The receiver plug can be inserted in the socket shown and the output of the receiver joined to the input of the amplifier. In addition the receiver and amplifier chassis should be joined together, except in the case of the 1936 Monodial AC Super, with which the negative HT point on the receiver should be joined to the amplifier chassis.

The heater winding on the mains transformer can, of course, be omitted and the valve heaters run from the amplifier. It will, however, often be more convenient to use the extra winding and leave that in the amplifier unconnected.

It may be remarked that the use of a separate HT supply for the receiver in this way has one technical advantage which is by no means to be despised. There is no possibility of feed-back from the output stage to the early valves and any tendency towards motor-boating should become non-existent.

In conclusion, the input/output curve of the amplifier is given in Fig. 3 for the modified condition of 300 volts on the anodes. It will be seen that the curve is nearly straight for outputs up to 10 watts. The overload point as shown by the cathode-ray oscillograph, however, occurs at an output of 8.2 watts. This output is with a 10,000-ohm load on the valves; an output of the same order is obtainable with a 6,000-ohm load, but the waveform deteriorates more rapidly when the overload point is passed. The frequency response curves are, of course, unchanged.

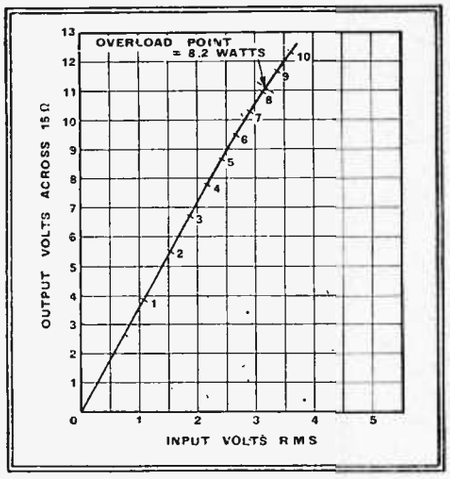


Fig. 3.—The input/output curve of the amplifier with the increased voltage shows good linearity. The output waveform begins to show distortion at 8.2 watts.

The issues of *The Wireless World* in which this amplifier was described have long been out of print, but a reprint of the combined articles dealing with the amplifier and its construction is available from the Publishers, Dorset House, Stamford Street, London, S.E.1, price 6d., or 7½d. post free.

Auditorium Acoustics

PART V.—CHARACTERISTICS REQUIRED FOR TALKING PICTURES AND BROADCASTING STUDIOS

By D. B. FOSTER, M.Sc., Ph.D.

THE previous article gave consideration to the acoustical requirements of auditoriums for the direct production of and listening to speech and music, and in this, the concluding instalment, the author deals with other types of studio, including rooms for broadcast reception.

THERE are a number of types of auditorium other than those used for direct listening to speech and music, and these include talking picture cinemas, talking picture studios, broadcasting studios, and rooms for the reception of broadcast programmes.

The requirements of all these auditoriums are the same with regard to the avoidance of major acoustical defects due to shape, such as echo, flutter echo, and focusing, but the optimum requirements differ essentially on the correct amount of reverberation. It will be recalled that reverberation has four functions: (a) it increases loudness due to cumulative reinforcement from reflected sound; (b) it reduces intelligibility by causing overlapping of successive sounds or syllables; (c) in large auditoriums reflecting surfaces must be employed to give good distribution to remote listeners, causing a certain minimum reverberation; (d) it is necessary for musical purposes as determined by artistic judgment.

In the talking picture cinema it is not necessary to have reverberation present to enhance loudness, since the loud speakers producing the sound are fed from electrical equipment which should be capable of supplying adequate loudness by varying the amount of amplification. Nor should reverberation be necessary from an artistic aspect, since the requisite amount of this type of reverberation should be present on the sound track. The illusion created by a talking picture is largely a function of the amount of reverberation in the reproduction which should correspond to that which one would naturally expect from the scene projected on the screen. For example, if the picture shows an outdoor scene one would expect this to be associated with complete absence of reverberation in the sound. Consequently an auditorium which itself introduced an appreciable amount of reverberation under these conditions would give rise to a loss of illusion. Since adequate loudness is provided by the loud speakers, the maximum intelligibility for speech reproduction will also occur with a minimum amount of reverberation.

Three of the four aspects of reverberation, therefore, indicate that the cinema should be relatively dead, but in practice, in order to achieve good distribution, it may be necessary to introduce an appreciable amount of reverberation particularly at the high frequencies.

Figs. 15 and 16 illustrate two talking picture cinemas, one relatively small, and the other relatively large, showing how the reverberation period has been kept down by the introduction of a suitable amount of sound absorption. In the case of the Gaumont, Chippenham, this has been obtained by the use of fabric-covered hair felt arranged in horizontal panels on the wall surfaces. The Gaumont Palace, Doncaster, also has a considerable area of acoustic absorption shown arranged in the decorated horizontal bands on the wall surfaces.

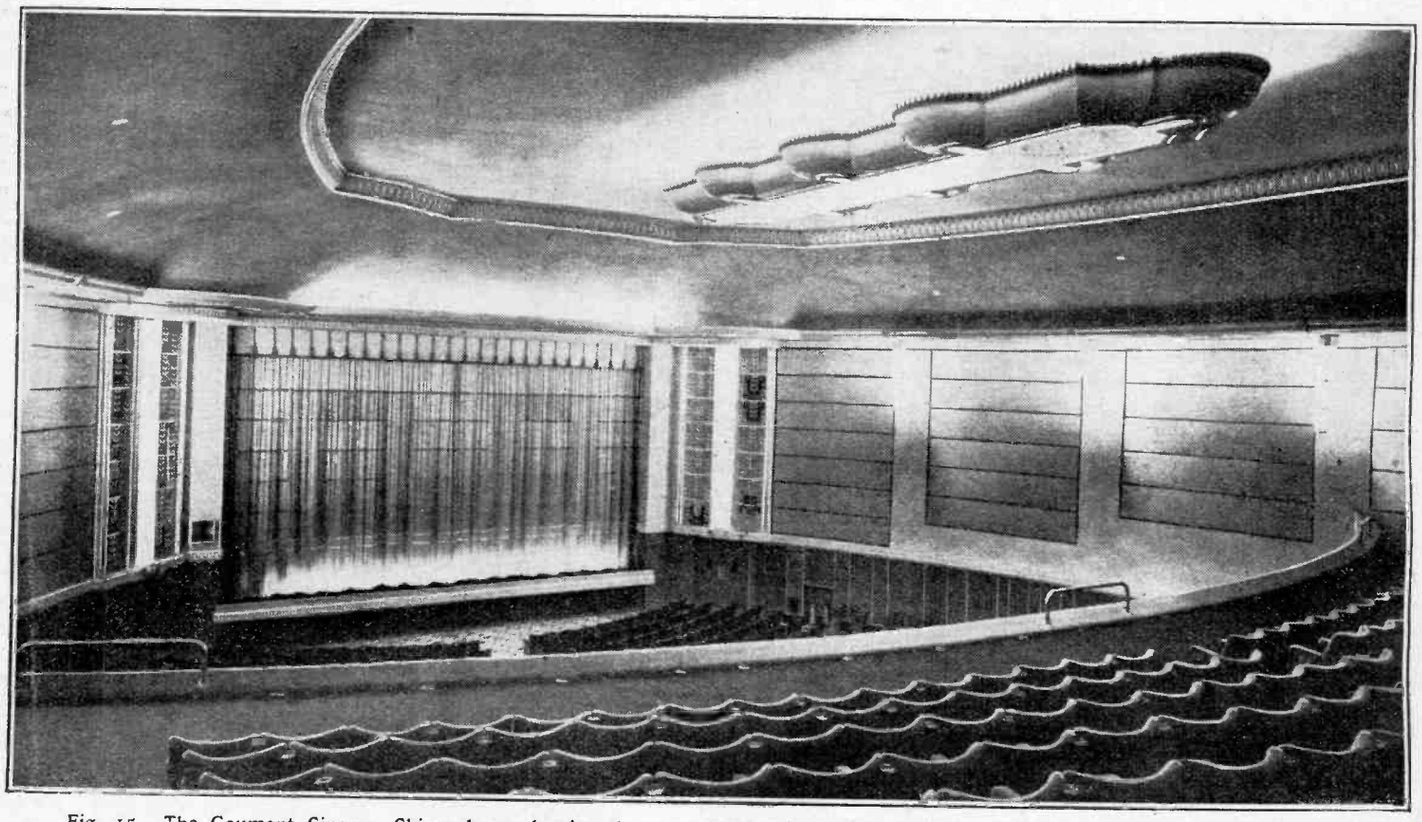


Fig. 15.—The Gaumont Cinema, Chippenham, showing the arrangement of acoustic absorption in large panels on the wall surfaces.

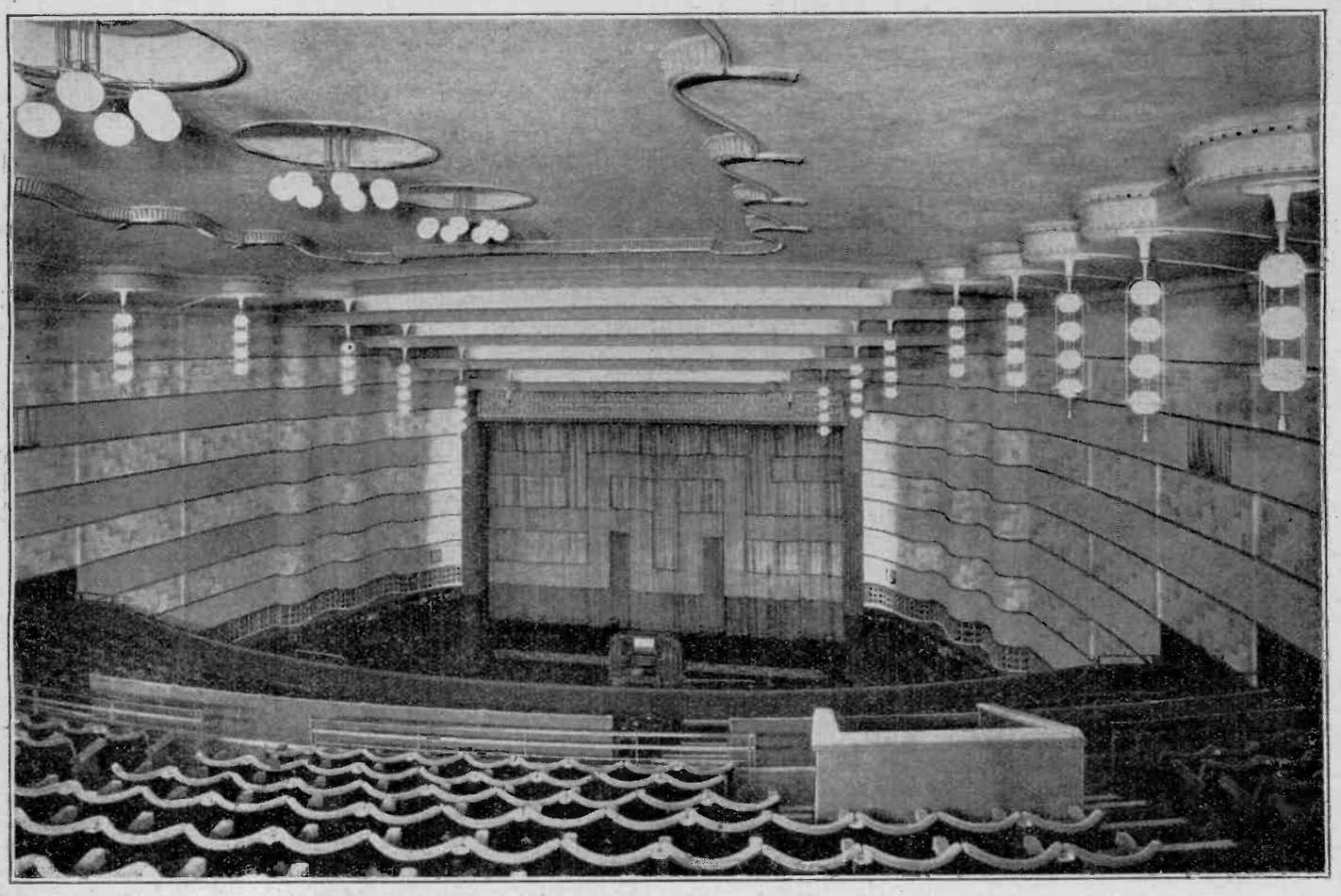


Fig. 16.—In the Gaumont Palace, Doncaster, acoustic absorption is concentrated in the horizontal decorated bands.

It is interesting to note that since the loudness can be maintained by electrical amplification, there is no theoretical limit to the size of a cinema of satisfactory acoustics providing the distribution is good and the reverberation can be kept down to a small value.

One other aspect of cinema acoustics requiring special attention is the space round and behind the loud speakers. The dimensions of these spaces are such as to give rise to air resonances causing boominess, and a large amount of absorption should be located here to minimise this effect.

The four types of auditorium considered are similar in that none is used alone for both the production of, and listening to, the sound, since use is made of an electrical transmission link between the studio where the sound is produced and the auditorium containing the listeners. This electrical link introduces its peculiar acoustical requirements due to the difference between monaural and binaural listening.

When, in the early days of recording and broadcasting, ordinary auditoriums were used for these purposes it was noticed that the sound reproduced electrically through a loud speaker had a more reverberant quality than that heard directly. This was due to the fact that the use of a microphone makes the sound appear as if heard through one ear only (monaural listening). With two ears (binaural listening) the sound reaches the ears at different times and with different intensities. These differences give perspective effect and help the listener to discriminate as to the direction of the source of the sound. He is thus enabled to concentrate on the direct sound and reject mentally some of the indirect reverberant sound. This aural rejection of some of the reverberant sound is equivalent to reducing the reverberation time. Consequently, to preserve the same quality under monaural or single-channel electrical channel conditions it is necessary either to reduce the normal reverberation or to increase the amount of direct sound relative to indirect sound by placing the microphone in a position closer to the source than would be occupied by a direct binaural listener. This effect can be checked for oneself by stopping up one ear and noting the apparent increase in reverberation. Experiments have been made using two microphones and separate transmission channels to two different earphones on either ear, and the binaural characteristics are then preserved.

Localised Reverberation

The acoustics of talking picture studios can be considered from two aspects, the overall studio acoustics and the set or scene acoustics. The studio may house several different sets (not intended for simultaneous use), and it is customary to make the studio as dead as possible and to build up the reverberation locally according to the acoustical illusion required by the individual scene. This arrangement also permits the equivalent of open-air acoustics to be attained for open-air scenes.

Fig. 17 shows a British talking-picture studio with maximum acoustic absorption on the wall and ceiling surfaces.

The method adopted to obtain the correct set acoustics will vary with the type of scene being portrayed. For example, if the scene is of a small room the set will probably have two side walls and a rear wall with no ceiling or front wall nearest the camera. Such an arrangement would probably be on the dead side compared with a normal six-sided room, but since a certain amount of reverberation will be introduced by the cinema when the film is projected the overall reverberation will be about right.

On the other hand, a set depicting the stage at the Queen's Hall might be much too dead on the studio, and it would then be necessary to introduce a number of highly reflecting surfaces round the set to increase the reverberation. Occasionally, if the set is still too dead, extra reverberation may be introduced after the sound has been picked up by the microphone by reproducing the sound through a loud speaker located in a highly reverberant room and then picking up this sound with a second microphone before recording.

Special precautions have to be taken in talking picture studios to exclude noise, since there is usually a lot of noise outside

Auditorium Acoustics—

due to other sets being built, and the walls should be of heavy construction with double doors, and each studio should be isolated structurally from the next.

The acoustical requirements for broadcast studios are good distribution, optimum reverberation, and very low background noise. Generally speaking, broadcast performances take place in rooms which are small relative to auditoriums which would be used for the direct hearing of such a performance. Consequently, fairly good distribution is easily obtained in small studios of conventional rectangular shape, since the major defects of echo, flutter-echo and focusing are usually associated with long reflective paths. The location of the absorption in the studio, however, should be uniform over all the surfaces so that the studio is equally reverberant in all planes.

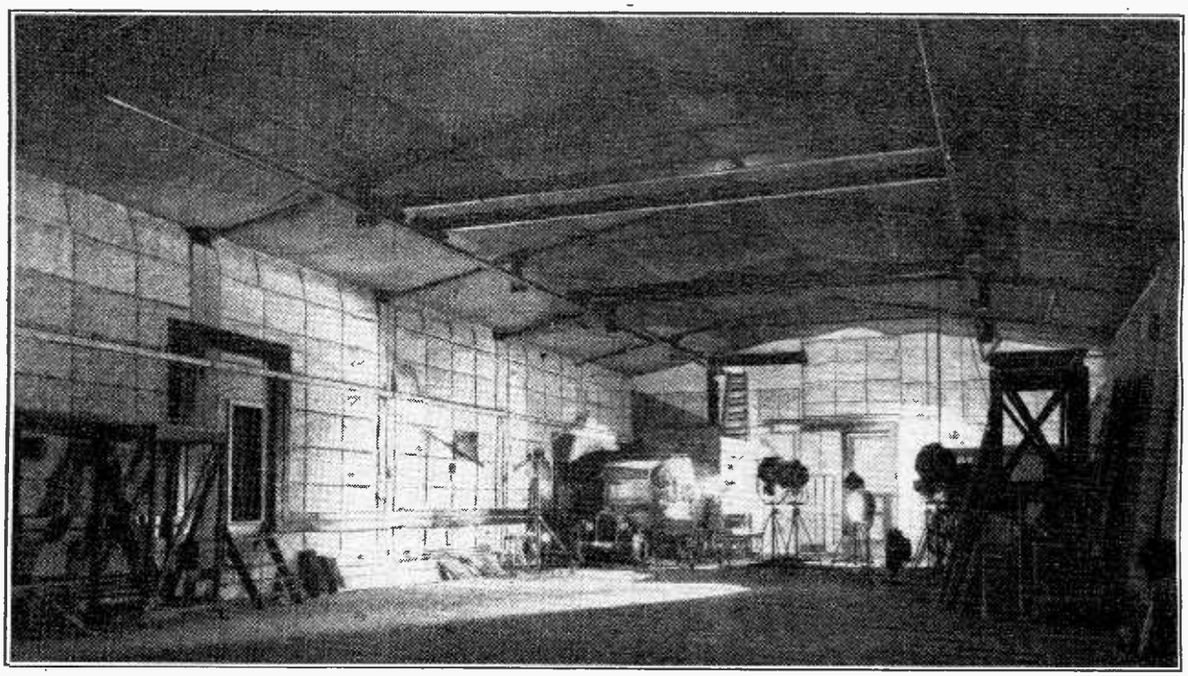
The optimum reverberation time for such studios will normally be considerably different from that of the auditorium in which such a musical performance would be rendered for direct listening. The studio reverberation has therefore to be adjusted by varying the total absorption until it corresponds to that which would obtain in the auditorium. Considerations of monaural listening make it permissible to have the studio acoustics a little on the dead side compared with the equivalent auditorium.

Since a studio may be used for several types of performance, it is useful to have its reverberation characteristics quickly adjustable, and hinged panels on the wall and ceiling surfaces which are absorbent on one side and relatively reflecting on the reverse side may be used to give adequate control. The reverberation time can then be adjusted to great accuracy according to the number and nature of the sides presented to the sound. The corresponding effect can also be obtained by having curtains on runners, matters being so arranged that they can be spread over varying areas of wall surface.

Since many studios may have to be accommodated within one building it may not be practicable entirely to isolate each one structurally to reduce mutual noise interference. A certain advantage may be gained by placing passages and administrative offices between the studios to increase the sound insulation. To guard against traffic noise windows may be eliminated and recourse made to forced ventilation, and the latter may be provided with absorbent ducts and sound traps to eliminate noise from the ventilation machinery.

The acoustics of an average room in a private house for radio listening will be concerned chiefly with the optimum location of the loud speaker and with good distribution. The reverberation time is not usually of importance in a room with average furnishings, since this will normally be short compared with that introduced in the studio. Occasionally the case arises of excessive reverberation in the horizontal plane due to complete absence of absorption, such as window curtains in this plane. This is easily remedied by the introduction of quite a small fabric hanging. The amount of reverberation introduced by the studio is normally adjusted to the optimum value while monitoring in a small room of this kind, and so it is both unnecessary and undesirable to attempt to change the reverberation characteristics of a listening room according to the nature of the broadcast. The room should not be too dead, however, in order to ensure good distribution, particularly at the top end of the frequency range.

The most common acoustical defect in home listening is air resonance characterised as boominess due to the incorrect location of the loud speaker. This resonance is often due to interaction between the air in the back of the cabinet and that trapped between the cabinet and the wall. The ideal arrangement is, of course, to place the cabinet with its back to an open window, but as this may annoy the neighbours or cause excessive draughts on winter nights the best compromise is to keep the cabinet as far from the wall as possible and at an angle to it. An improvement may also result from hanging a thick curtain a few inches away from the wall at the back of the cabinet, or this may be achieved by associating the loud speaker with the window curtains.



Courtesy, Western Electric

Fig. 17.—Interior of a typical British talking picture studio with heavy sound absorption on the wall and ceiling surfaces.

News from the Clubs

Edgware Short-wave Society

Headquarters: 40, Raeburn Road, Edgware.
Meetings: Sundays at 11 a.m. and Wednesdays at 8 p.m.
Hon. Sec.: Mr. G. Yale, 40, Raeburn Road, Edgware.

The Society has applied to the G.P.O. for a transmitting licence. Morse classes are now held every week.

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

At a recent meeting Mr. Garry Allighan, the well-known journalist, gave a talk entitled "Searchlight on the B.B.C." The lecturer attacked the B.B.C. on account of the large amount of time devoted to programmes of the "highbrow" type. In the discussion which followed a member took the lecturer to task for thinking that listeners preferred certain sponsored programmes from abroad rather than the B.B.C.'s efforts. The meeting was very divided on the question.

Maidstone Amateur Radio Society

Headquarters: 244, Upper Fant Road, Maidstone.
Meetings: Tuesdays at 7.45 p.m.
Hon. Sec.: Mr. P. M. S. Hedgeland, 8, Hayle Road, Maidstone, Kent.

The members of this Club, which was started in August, now number twenty-two, and include several well-known transmitters. The subscription is 3d. per week, the entrance fee being 6d. There are now nearly four hundred radio publications in the Club's library. Apart from the regular meeting nights the clubroom can be opened by request on almost any evening in the week; also on Sundays and on Wednesday and Saturday afternoons.

CLUB WANTED. A reader living at Sherborne, Dorset, is desirous of joining a radio club. We should be glad if secretaries of societies in the district would communicate with us.

CURRENT TOPICS

EVENTS OF THE WEEK IN BRIEF REVIEW

Another 100 KW. Station

IT has been decided to replace the existing transmitter at Limoges with one of 100 kW. power. It will, however, be fully a year before it is in operation.

Marconi Museum

THE Italian Government are to convert the yacht "Elettra" into a museum of Marconi's work. The offer of an American scientific society to buy the yacht has been refused.

Illegal Listening

THERE were 396 successful wireless prosecutions during November, and, as a result of a raid on a nest of alleged licence-dodgers in the Harrow and Wealdstone district, 51 cases are *sub judice* at the local police court.

World Radio Convention

FROM April 4th to the 14th there is being held at Sydney, N.S.W., a World Radio Convention at which several prominent personalities have promised to attend. Among these are Mr. David Sarnoff, the President of the R.C.A., and the Marchesa Marconi. It is highly probable that Sir Noel Asbridge will also be present, as well as several leading radio engineers from Holland. It is hoped to arrange for the first session of the Convention to be declared open by a member of the Royal Family speaking by wireless telephone from England. Intending visitors will be interested to know that the convention is being held during the final part of Australia's 150 years celebrations.

Television in the Cinema

SEVERAL questions have been asked in the House of Commons concerning the legality of cinemas receiving the B.B.C. television programmes and exhibiting them on the screen. In particular, mention was made of the demonstration given on December 7th in a Bromley cinema. The P.M.G. in his reply pointed out that, provided the cinemas in question held an ordinary wireless receiving licence, there was nothing to prevent their receiving the television programmes so far as the Wireless Telegraphy Acts were concerned, but he intimated that this did not mean that they were permitted to infringe copyright.

In reply to another question the P.M.G. said that the possible use by cinemas of B.B.C. television programmes did not have any immediate bearing on the contemplated supplementary grant to the B.B.C., which was for the purpose of covering television broadcasts during the current year.

The P.M.G. also dealt with a question regarding the remuneration of the B.B.C. governors during the years 1936 and 1937. In the former year, under the original charter at the B.B.C., the amounts due were £3,000 Chairman, £1,000 to the Vice-chairman, and £700 to each of the three other governors. In 1937, under the new charter, the Chairman and Vice-chairman received the same amount, but each of the other governors, including two extra ones, received £1,000.

Faeringehavn

ONE of the least-known broadcasting stations is probably that at Faeringehavn, on the south-west coast of Greenland. The port of Faeringehavn, which has been declared open for navigation, is a new base for fishing fleets operating in that part of the world. To make the harbour accessible and suitable as a base various leading marks and lights have been erected. In addition, there is now a shipwright's yard, a motor repair shop and a hospital. At present no information is available concerning wavelength and power of the station.

Cheap Listening

THE system of wireless licensing in Lithuania differs greatly from ours. The amount payable varies not only according to the type of set in use, but, in the case of a mains set, according to the locality in which it is used. Licence fees are payable quarterly, and during the third quarter of the year are reduced by 50 per cent. The quarterly fees vary from 2 lits for a crystal set to 9 lits for a mains-operated set used in Kaunas or Klapeida. Transmitting licences cost 10 lits initially and 2 lits per quarter thereafter. Since the value of the lit is only 8½d., it will be seen that listening is very inexpensive.

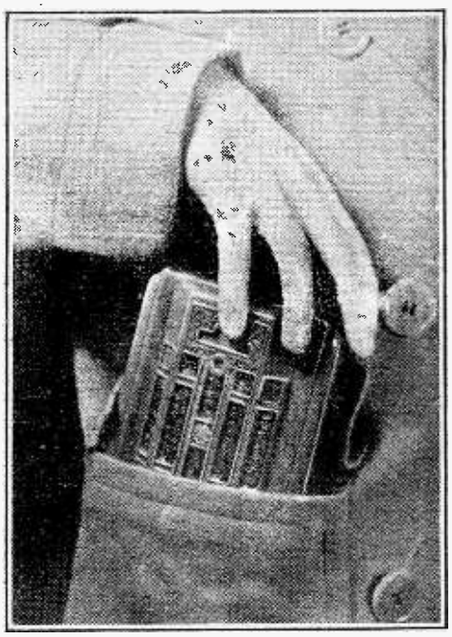
Interesting Indian Experiment

FURTHER details are now available concerning the scheme, to which we recently referred, for covering the Delhi Province with a network of 120 receiving sets installed in various villages.

At intervals throughout the Province there will be battery-charging stations, the location of these being such that no village will be at a greater distance than six miles from one of them. At these stations there will be a skilled service-man to undertake any repairs to sets that may be necessary.

A record will be kept of the results achieved. In particular, note will be made of the extent to which the advice on crops has been useful, and a special official will be appointed to go round the villages finding out what sort of programmes listeners prefer.

If sanctioned, as expected, the scheme's total cost for the three-year experimental period during which it is proposed to operate it will be in the neighbourhood of £7,700.



POCKET MAINS SET.—According to an American correspondent, this set, which weighs "all of two pounds," is the smallest in regular commercial production in the U.S.A. It is an AC/DC model, employing two valves in a new type of circuit.

Physical Society's Exhibition

THE Twenty-eighth Annual Exhibition of Scientific Instruments and Apparatus arranged by the Physical Society will be held at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, London, S.W.7, on January 4th, 5th, and 6th. On the first and last days it will be open from 2.30 p.m. to 9 p.m., but on the second day the opening hour will be 4 p.m. Admission is by ticket, which may be obtained from the Exhibition Secretary, 1, Lowther Gardens, Exhibition Road, London, S.W.7. Members of institutions and scientific societies may obtain tickets through their secretaries.

Portable Police Transmitter

IT is well known that for many years the Brighton police have employed a small portable receiver. The Viennese police have gone one better, insomuch that they have developed a fixed-wavelength "pocket" transmitter. Telegraphy is, however, used. The transmitter is contained in a small box suspended at chest level by an insulated cable around the policeman's neck, this cable also acting as the aerial. The batteries are contained in the pocket. The whole outfit, which includes 60 volts HT, weighs less than 2¼ lb. The range is small, being only about 1¼ miles.

Prison Radio

A NEW broadcast receiver has been installed in the gaol at Vellore (Madras) for the benefit of prisoners. It is understood that similar sets will be installed at other Indian prisons.

"Facsimile" Experiments in America

AS reported in *The Wireless World* on October 29th, experiments have for some time past been carried out in the U.S.A. in transmitting weather maps, etc., by facsimile wireless. Similar experimental work is now being done with the transmission of Press news. According to the American publication, *Broadcasting*, four stations have already been granted the necessary licence for facsimile experiments on the broadcast band of wavelengths, and six other stations have applications pending. Other stations are already experimenting with facsimile work on special wavebands. Several receiving stations have been set up in order to co-operate in this work, which is carried out for the most part between midnight and 6 a.m. Different systems are in operation.

AVC Shortcomings

DISTORTION DUE TO THE DELAYED DIODE METHOD

By K. R. STURLEY, Ph.D., A.M.I.E.E.

THE author describes the nature and extent of the distortion that may, in certain circumstances, be produced by delayed AVC, and enumerates the precautions that should be taken to reduce this trouble to negligible proportions.

AUTOMATIC control of volume adds so much to the entertainment value of broadcast receivers that it is almost always used in sets employing diode detectors.

The fundamental principle underlying all AVC systems is the use of the DC component produced by detection of the input carrier voltage to control the bias on the RF amplifier valves. The full gain of the receiver is required for small input signals, and it is usual to delay the AVC action until a certain signal level has been reached. Generally this delayed action is obtained by using a separate detector valve biased with a negative voltage, termed the delay voltage, which prevents detection below a given signal level.

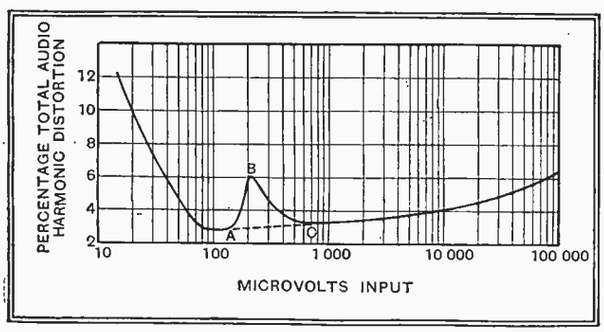


Fig. 1.—Typical distortion curve for receiver fitted with delayed diode AVC.

Some while ago the author had occasion to measure the audio distortion produced in a radio receiver fitted with delayed AVC for various values of input signal voltages modulated by a frequency of 400 c/s. Care was, of course, taken to see that distortion in the signal generator supplying the input signal was small. The form of the distortion curve so obtained is shown in Fig. 1. Noise in the receiver produced a large value of apparent distortion for small signals, but this decreased to quite a low value as soon as the input was increased. It was expected that distortion would increase slightly as the input was increased until overloading of the output valve occurred. The sudden rise of distortion at A to a maximum at B and the fall back to normal at C (shown by the curve in Fig. 1) was, however, inexplicable until it was observed that A corresponded to the point where the AVC was coming into action. This theory was tested by disconnecting the AVC bias and using manual control on the RF valves. The manual bias was adjusted for each input voltage to give the same output as the AVC bias. A curve was then obtained almost identical with that for Fig. 1, but with A and C joined as shown by the dotted line. It was therefore evident that the AVC circuit was responsible for this extra distortion.

Experiments were next planned to try to find the conditions governing the production of distortion by AVC circuits. A standard signal generator was modulated by a frequency of 400 c/s from which all harmonics had been filtered and its output connected to the grid of an RF pentode, as shown in Fig. 2. The pentode had in its anode circuit an IF transformer, the primary and secondary circuits of which were tuned to 110 kc/s. The AVC diode was connected to the anode by C1, and the delay voltage was inserted between the cathode of the diode and earth. The DC path for the diode was completed by the shunt resistance RD, and the resistance-capacity filter, RF and C2, allowed only the DC bias to be applied to the AVC line. To the secondary of the transformer was connected a diode followed by an AF amplifier and a distortion factor meter, which measured the total harmonic distortion of the 400 c/s modulation. The distortion in the apparatus when the AVC diode was disconnected was reduced to a low value, about 1 per cent. The AVC voltage was not used for control purposes, and two series of tests were carried out, one with and one without the resistance-capacity filter, RF and C2.

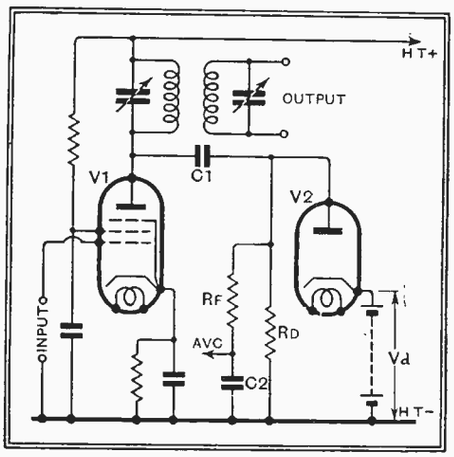


Fig. 2.—Typical circuit for delayed diode automatic volume control.

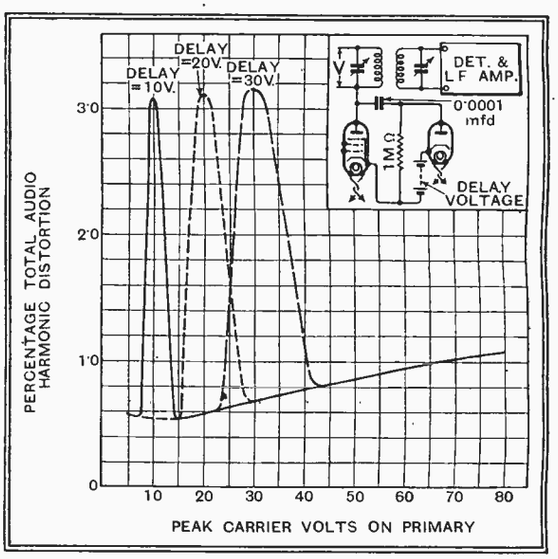


Fig. 3.—Audio distortion produced by an AVC diode with different delay voltages; 30% modulation of carrier.

Interpreting Distortion Curves

In the first test the effect of variable delay voltage was noted, and in Fig. 3 are plotted curves of distortion against carrier peak voltage (modulated 30 per cent.) developed across the primary of the transformer. The first point to observe from the curves is that the maximum value of distortion was independent of delay voltage, and that it always occurred at a carrier peak voltage equal to the delay voltage. If we examine the curve for 10 volts delay we see that distortion appeared at a carrier voltage of 7.7 volts and disappeared at 14.3 volts. Now, if a carrier has a peak voltage of $\hat{E}$ and is modulated M%, the modulation envelope varies from $\hat{E}(1+M)$ to $\hat{E}(1-M)$. Thus, the modulation envelope for a carrier voltage (with 30% modulation) of 7.7 volts has a maximum amplitude of $7.7(1+0.3)=10$ volts, and similarly a carrier of 14.3 volts has a minimum value of $14.3(1-0.3)=10$ volts.

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The curves for 20 and 30 volts delay give the same results, so that we have found that the limits of distortion are from $\hat{E}1$ to $\hat{E}3$, where $\hat{E}1 = \frac{Vd}{1+M}$ and $\hat{E}3 = \frac{Vd}{1-M}$ with a maximum when the carrier peak voltage $\hat{E}2$ equals the delay voltage Vd. In other words, distortion starts as soon as the modulation envelope exceeds the delay voltage, and ends when the trough of the modulation envelope exceeds the delay voltage.

The next experiment was concerned with the effect of modulation percentage variation for a fixed delay voltage, and the curves for this are plotted in Fig. 4. The carrier peak voltage for maximum distortion was the same for all values of modulation percentage, and was equal to the delay voltage. The value of maximum distortion was unaffected by modulation percentage variation, and the slight increase was mainly due to the associated apparatus. The range of carrier peak voltage over which distortion occurred increased with the percentage modulation in accordance with the expressions for $\hat{E}1$ and $\hat{E}3$ given above.

The effect of variation of the shunt resistance was examined, and the results are plotted in Fig. 5 for a delay voltage of 10 and 30 per cent. modulation. Distortion increased as resistance decreased, but the limits of the distortion range and the point of maximum distortion were unaffected.

Variation of the anode circuit impedance by paralleling the primary of the transformer by a resistance R had the opposite effect, as shown in Fig. 6. Decrease of this resistance decreased distortion, but again had no effect on distortion range or position.

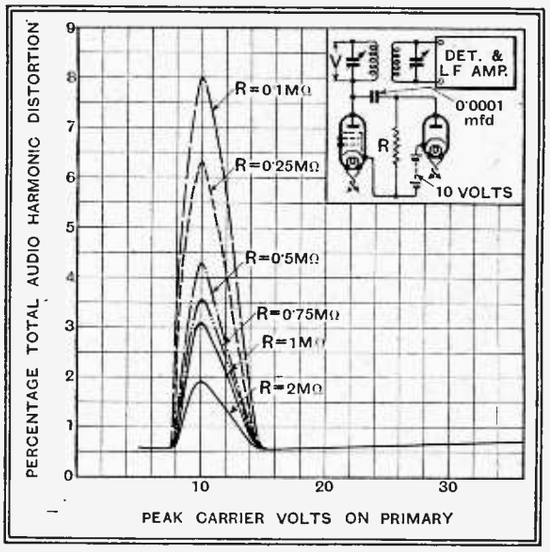

Fig. 5.—Effect of diode shunt resistance on the audio distortion. Delay voltage = 10; 30% modulation of carrier.

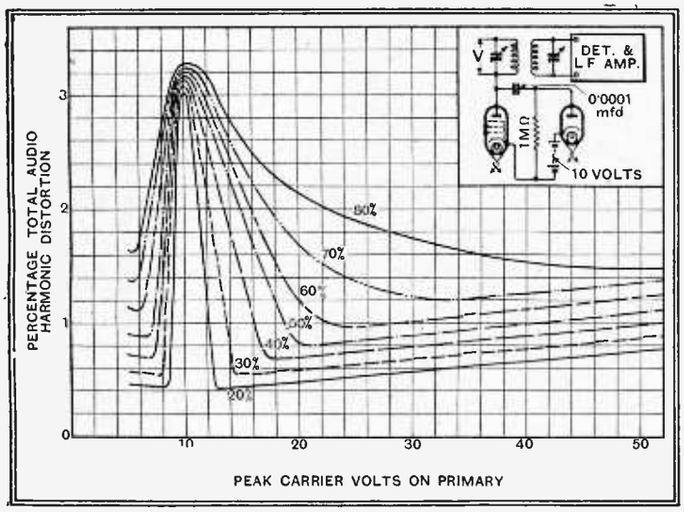

Fig. 4.—Effect of percentage modulation on the audio distortion produced by an AVC diode. Delay voltage = 10.

We can now summarise the results of the investigations so far:—

(1) Distortion was introduced by the AVC diode at a carrier peak voltage equal to $\frac{Vd}{1+M}$; that is, when the modulation peak entered the diode conductive region.

(2) Distortion reached a maximum at a voltage equal to Vd; i.e., half the modulation envelope had entered the diode conductive region.

(3) Distortion was removed when the carrier voltage exceeded $\frac{Vd}{1-M}$; that is, when all the modulation envelope had entered the diode conductive region.

(4) Decrease of the AVC diode shunt resistance increased distortion.

(5) Decrease of the pentode anode circuit impedance decreased distortion.

We now have sufficient data to formulate a theory of how this distortion is produced by the AVC diode. Clearly the latter cannot affect the output conditions until it becomes conductive, and this does not occur until the RF valve gives an output voltage which exceeds the delay voltage. This explains why the expression $\hat{E} = \frac{Vd}{1+M}$ gives the carrier peak voltage at which distortion appears, for then the tip of the positive modulation envelope is just entering the conductive region of the diode. The RF pentode valve can be regarded as a generator of constant current,[1] all of which will pass through the primary of the IF transformer unless an alternative path is provided. As soon as the diode conducts, it provides an alternative path, and some of the current is diverted from the primary to the diode. The voltage across the primary is the product of the current and the impedance, and therefore falls when the current is reduced. Hence the voltage across the transformer primary is less than normal during the diode conductive period. This is illustrated for a modulated wave in Fig. 7a, *b* and *c*. In Fig. 7*a* and 7*b* the dotted line indicates the modulation envelope if the AVC diode

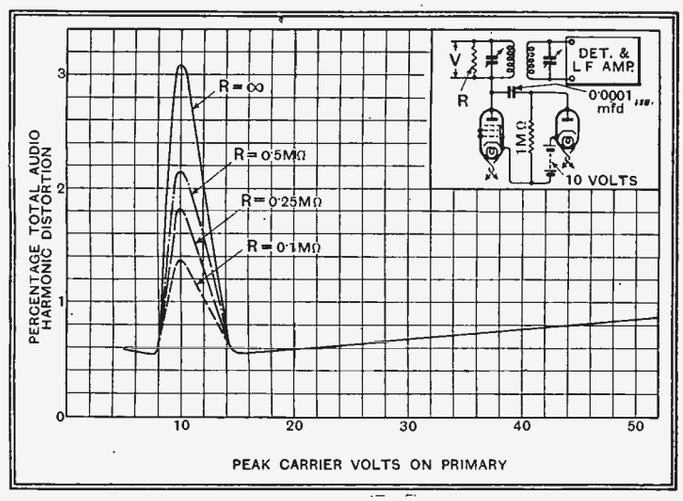

Fig. 6.—Effect of resistance in parallel with anode circuit on the audio distortion. Delay voltage = 10; 30% modulation of carrier.

[1] A pentode valve may conveniently be regarded as a constant current generator because its anode current is practically independent of anode voltage and determined for a given screen voltage only by the grid voltage. The generated current is given by $gm \times eg$ where gm = mutual conductance of the valve.

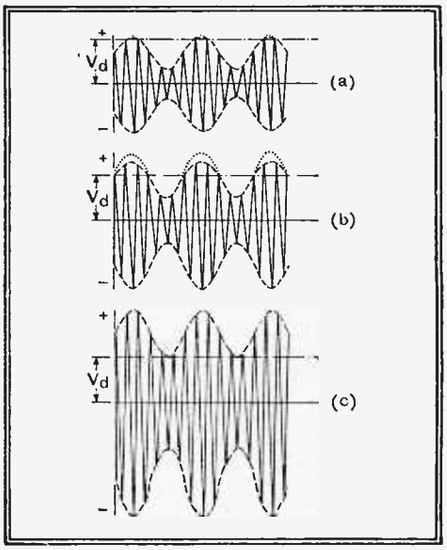

Fig. 7.—(a) Modulation envelope entering diode conductive region. (b) Modulation envelope half inside diode conductive region. (c) Modulation envelope completely inside the diode conductive region.

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is removed. The modulation envelope has just exceeded the delay voltage in Fig. 7*a*, and a "kink" is produced at the point where the envelope amplitude equals the delay voltage. This "kink" represents distortion of the modulation envelope, and as the signal is increased the "kink" moves down the modulation envelope until, when the signal equals the delay voltage (Fig. 7*b*), the modulation envelope consists of two half sine waves of different amplitude. This is the worst condition for distortion, and, as the signal is increased still further, the envelope becomes less distorted. When all the modulation envelope (Fig. 7*c*) is inside the diode conductive region, it has no "kink," but follows exactly the original shape, and is only reduced in amplitude. This is then a condition of no distortion.

Increase of modulation percentage means a bigger modulation envelope, and the carrier voltage required to take the envelope to Vd will be less, whilst that required to take it beyond Vd will be greater. The abrupt change at Vd will, however, be the same whatever the modulation percentage, so distortion will not be higher but merely spread over a larger range of carrier voltage.

Let us consider next the effect of R_D. As R_D is decreased more current is diverted to the diode, and so less is available for the primary across which the voltage will be still more reduced. The "kink" between the modulation envelope will be more pronounced and more distortion will be present.

In the same way, if the primary circuit impedance is reduced, more current will flow through it and less will be diverted to the diode. The "kink" is less pronounced and distortion is reduced.

We have thus established a theory for the production of distortion by an AVC diode without a filter, and now we must consider the case when a resistance-capacity filter is employed.

The curves in Figs. 8 and 9 give the results for two values of modulation percentage when the filter resistance R_F is varied. Distortion appeared as before at a carrier peak voltage $\hat{E}_1 = \frac{Vd}{1+M}$, but the maximum did not occur when $\hat{E}_2 = Vd$, and certainly did not disappear when $\hat{E}_3 = \frac{Vd}{1-M}$. Furthermore, the carrier voltage for maximum distortion was no longer independent of the modulation percentage, though the actual value of distortion was independent. Since we have established already that it is the delay voltage which controls the range of distortion, it is clear that some change must be taking place in the effective value of the delay voltage. The increase in distortion as R_F was decreased also showed that the equivalent shunt resistance for the diode was decreased. A previous paper[2] has shown that the addition of a resistance capacity filter (where the capacitive impedance is much less than the resistance at audio frequencies) across the diode shunt resistance R_D has exactly the effect, viz., that an extra equivalent delay voltage is introduced which varies with the carrier voltage and the ratio $\frac{R_D R_F}{R_D + R_F}$, and the equivalent shunt resistance is decreased from R_D to $\frac{R_D R_F}{R_D + R_F}$.

The author has given elsewhere[3] the following formulæ for the carrier voltage range over which distortion is introduced.

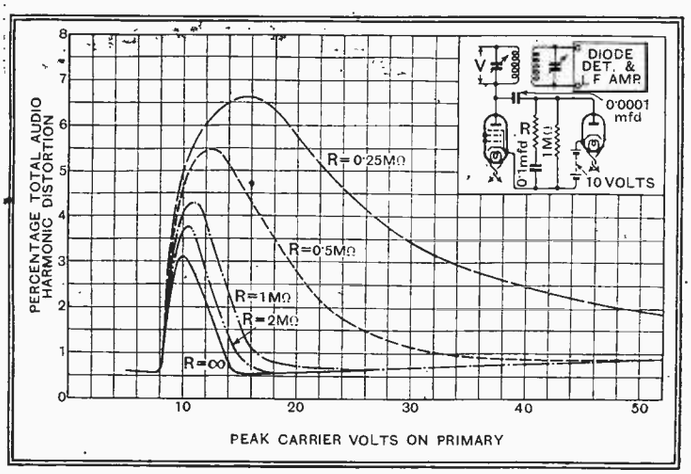


Fig. 8.—Effect of variation of filter resistance R_F on the audio distortion. Delay voltage = 10 ; 30% modulation of carrier.

The range is from :—

$$\hat{E}_1 = \frac{Vd}{1+M} \text{ to } \hat{E}_3 = \frac{Vd}{1 - M\left(\frac{R_F + R_D}{R_F}\right)}$$

with a maximum at $\hat{E}_2 = \frac{Vd}{1 - \frac{M}{\pi}\left(\frac{R_D}{R_F + R_D}\right)}$

and these formulæ will be found to give very good agreement with the results plotted in Figs. 8 and 9.

We have already pointed out that the diversion of current from the transformer primary to the diode is responsible for this distortion, so we should expect the maximum values of distortion for the same equivalent diode shunt resistance to be the same with the filter as without. The curves in Figs. 5 and 8 show that when R'_D (Fig. 5) $= \frac{R_D \; R_F}{R_D + R_F}$ (Fig. 8), the maximum distortion is the same.

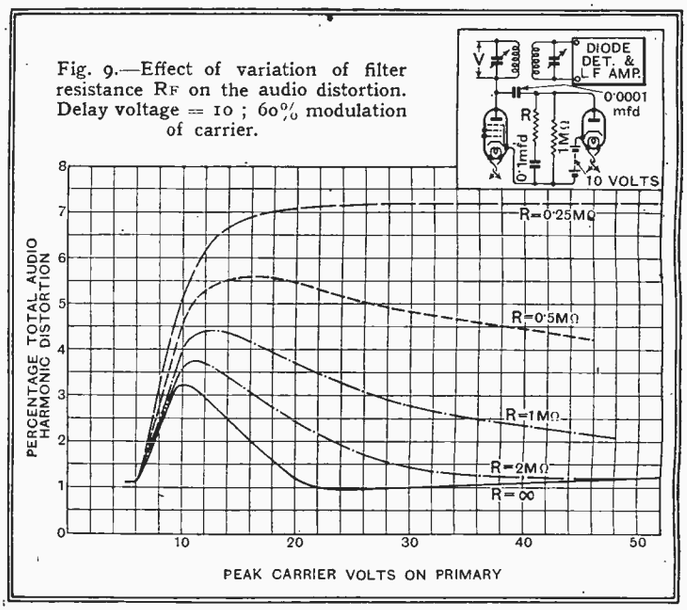


Fig. 9.—Effect of variation of filter resistance R_F on the audio distortion. Delay voltage = 10 ; 60% modulation of carrier.

The following points should therefore be observed if distortion due to delayed diode AVC is to be reduced.

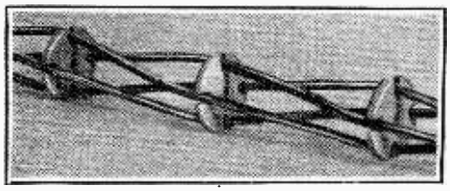
(1) The diode shunt resistance R_D should be as high as possible, preferably not less than 0.5 megohm. This reduces the transfer of current from the transformer primary to the diode.

(2) The filter resistance R_F should be large, and not less than R_D. This has the same effect as in (1), but, in addition, reduces the effective delay voltage and the value of $\hat{E}_3$, the carrier voltage, where distortion appears.

(3) The transformer impedance in the RF amplifier should be as low as possible commensurate with good gain and low distortion. This means less current transfer to the AVC diode; and

(4) The delay voltage should not be so high as to bring the point of maximum distortion at a carrier voltage corresponding to the local station.

In conclusion, the author wishes to make acknowledgment to the Cosmos Lamp Works for permission to publish these results.



TO AVOID LOSSES due to insulating materials in cables for carrying the high frequencies used in television work, air-spacing is employed as shown in this view of an uncased portion of the new A.E.G. (German) television cable.

[2] "Diode Detectors," J. L. Foot, *The Wireless World*, December 28th, 1934.

[3] "Distortion Due to Delayed Diode AVC," K. R. Sturley, *The Wireless Engineer*, Jan., 1937.

The Dellinger Effect

By "CATHODE RAY"

WAVES THAT ARE LOST IN SPACE

TO the vast majority of people radio means medium- and long-wave local broadcasting, with no thought of any interruption of the regular service other than the odd 0.01 per cent. (or thereabouts) of the time devoted to what would be officially described by the B.B.C. as the "technical hitch." Of course, distant stations are unsatisfactory at times, and now that "all-wave" sets are the rule rather than the exception, realisation of dependence on a not entirely reliable Nature for the conveyance of the programmes through space is, no doubt, growing. But only commercial operators and some amateur short-wave workers have any experience of how much they are at the mercy of the elements for holding aloft the invisible lines of communication.

It is really rather romantic and early—H. G. Wellsian. I don't know whether anybody has ever written a "scientifiction" story based on the idea of a sudden complete disruption of all radio communication, but it could hardly be more far-fetched than the truth. Not as regards the completeness of the disorganisation, of course, because actual radio "fade-outs" fortunately appear to be confined to the short wavebands; but as regards the way it happens.

Sudden Fade-out

On a number of occasions a few years ago operators were receiving signals quite comfortably on the regular schedule, when, without warning, reception ceased. A sudden deep fade is usually followed almost at once by a reappearance. But no, it does not come back. Has the transmitter broken down? What are other stations' signals like? There aren't any! The receiver is dead. It must have sprung a fault somewhere!

And so the operator has tested the receiver, taken it to bits, and failed to find anything wrong with it. After perhaps half an hour (if he has given up his vain search and got his apparatus together again by then) everything has been normal. Apart from some curses on the perversity of wireless apparatus in general, that has often been an end of the matter. But when it began to be found that other operators and listeners were experiencing the same thing at exactly the same time all over the country, and in other countries, it became obvious that here was some natural effect quite different from the various types of fading and irregularity commonly observed.

J. M. Dellinger, of the American Bureau of Standards (corresponding to our N.P.L.), appears to have been the first to recognise this radio fade-out as a definite phenomenon, and during the last two years he has been studying it and collecting a vast quantity of observations on it from all over the world, and now presents a summary of the findings.[1]

One of the first things to be noticed was that the interruption occurs only over the sunlit hemisphere of the earth. That immediately suggested the sun as a cause, especially as it was already known to influence the propagation of radio waves. So the astronomers were given the tip to examine their records for the times covered by the interruptions. Then, because sunstorms are known to affect the electrical and magnetic conditions of the earth, the scientists who observe these things were also roped into the job. And their observations were very interesting.

At exactly the times occupied by the radio interruptions, as nearly as could be ascertained, the astronomers reported that violent eruptions were in progress on the sun. Not all such eruptions are accompanied by radio interruptions. Evidently the particular sort of solar radiation responsible for the trouble is a product only of a certain type of eruption.

Then the other observers reported that at the same times as the radio effects occurred their records of earth currents and earth's magnetism showed sudden fluctuation, and that these irregularities were different from those known for a long time as "magnetic storms," which are usually accompanied by atmospherics but not complete fading-out of signals.

And so the nature of the effect has gradually been elucidated. As most of those interested in short waves know, the transmission of signals over anything more than very short distances depends on the maintenance of certain reflecting layers in the upper atmosphere. Otherwise the waves would just leave the earth and never come back. These layers are maintained rather precariously by the ionisation (separation into electrically positive and negative constituents) of the rarified air at these heights. The rate of ionisation, in turn, depends very largely in the intensity of sunlight. When I say sunlight I am using the word in a broader sense than usual to include radiation (such as ultra-violet) outside the wavelengths to which the eye is tuned. At night, when there is no sunlight, the ionised layers are composed in such a way as to reflect radio signals of certain wavelengths; during the day the radiation from the sun alters the balance of ionisation, and the reflecting layers become most effective for signals of shorter wavelength. Everybody with a short-wave receiver soon finds this out.

The sun, so far from being the steady light it looks like, is torn by fiery storms big enough to toss a body the size of the earth like a rock from a volcano. These eruptions throw out bursts of radiation on different wavelengths in the same way that the light from a distant bonfire looks sometimes white and sometimes red. Occasionally the radiation is of such a wavelength as to penetrate the reflecting layers around the earth and cause ionisation at lower levels of such an intensity as to absorb rather than reflect.

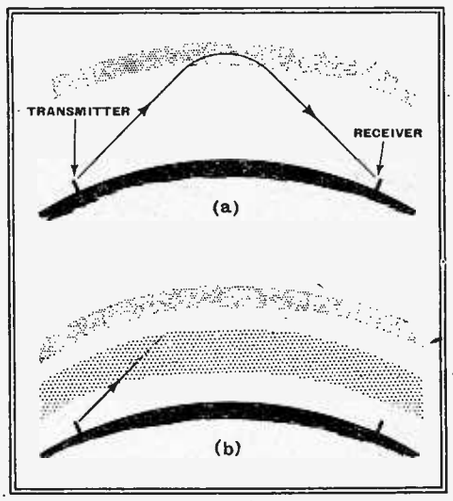


Fig. 1.—(a) Long-distance short-wave radio depends on reflection from the ionised layers in the upper atmosphere to get the waves round the curvature of the earth. (The vertical scale is exaggerated here). (b.) When certain storms occur in the sun, such communication is entirely suspended, due, it is believed, to the formation of an intervening absorbent layer.

It is as if a smoke-screen were released in front of a mirror (Fig. 1). The lower ionised layer is opaque to those radio waves shorter than about 200 metres that are being reflected to their destinations by the higher layers. So they never get there. An eruption breaks out on the sun, and in eight minutes the effects of it have reached the earth, 93,000,000 miles away, and have switched off short-wave wireless to and from all stations in daylight.

The fade-out lasts anything from a few minutes to over an hour. It is much more complete than the worst moments of fading that normally occur. Even the

[1] Proceedings of the Institute of Radio Engineers, October, 1937.

The Dellinger Effect—

noise of atmospherics more or less stops. Everything within the wide band from 1.5 to 30 Mc/s (10 to 200 metres) is liable to be affected, though not in an identical manner.

Much has already been learned about what is going on as a result of these solar activities, but some of the features are still obscure. Study of this matter seems to be yielding information not only for radio engineers but also for astronomers and scientists in a variety of departments.

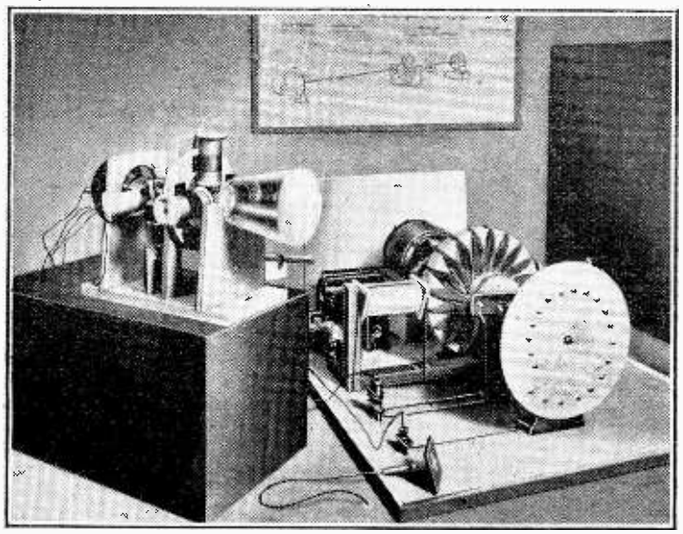
Incidentally, the observations of amateurs, if systematic, are thankfully received by the investigators.

Germany's Television Show

THE DEUTSCHES MUSEUM EXHIBITION

From Our Berlin Correspondent

DURING a recent visit to Munich, Germany's second capital (it is the seat of the National Socialist Party), I was able to visit the Television Exhibition arranged by the famous German Science Museum.



Courtesy, Deutches Museum, Munich

MODERN FLAVOUR. Few would guess that Professor Dieckmann's picture transmitter and receiver, as shown at the recent Munich Exhibition, are over 30 years old.

As an addition to the permanent section, "Picture Telegraphy and Television," the Museum decided to arrange a special exhibition of television to illustrate technical development from the crude apparatus of Nipkow to the modern German 180-line television-telephone and television broadcasting.

The show, though primarily educational, is also historical, and it is probably only in the nature of things that Germany's contributions to television are stressed. The name of Baird does not appear, but there is an Iconoscope, presented by the inventor, Dr. Zworykin.

My walk through the exhibition was like a visit to old friends, and many of the "historical" exhibits were those acclaimed only a few years ago as the last word. In this category were the original intermediate-film apparatus, last seen in the laboratories of the Fernseh A.-G. some years ago, the Telefunken-Karolus 3,000-lamp television screen which was the sensation of the 1935 Berlin Radio Exhibition, the Iconoscope camera used during the Olympic Games last year, and Denes von Mihaly's "Telehor."

The exhibition itself is built up on instructive lines. The action of the photo-electric cell and the processes of scanning and synchronising are demonstrated and their method of operation is clearly explained.

The Kerr effect, called after the inventor, the Englishman Kerr (1875), and adapted to modern purposes by Professor Karolus in the form of the familiar "Kerr Cell," is explained and demonstrated.

Different Nipkow discs for from 30 to 375 lines are shown. The latter has four rows of spirals so that four revolutions are necessary for one frame. The very latest lens-drum and mirror screw, etc., are also on view.

Synchronisation is first demonstrated to the visitor and then a large number of methods are shown. Dr. Schriever's (Telefunken) system is at present employed in Germany. Briefly, it consists of modulating the transmitter in such a manner that a black spot in the image is one quarter of the amplitude of a white spot. This "under black" current is then reduced to zero for a moment at the end of each line and for a longer time at the end of each frame.

Films showing the varying effects of definition by means of pictures with 30, 48, 60, 90 and 180 lines are demonstrated.

A model of the Berlin Witzleben television transmitter is also a feature of the show. Good television reception from it is given at a range of 25 km. in town and 100 km. over open country. Samples of the new German television cables are shown. These are of special interest in view of the recent successful operation of television over them on distances of over 300 miles. Repeaters are required every 22 miles for frequencies up to 1 megacycle.

Frequencies between one and four megacycles, which will be required for 441-line definition, will have to pass through a repeater every 11 miles. The engineers have already produced a system which permits of dividing the frequencies so that the lower band is passed to a repeater only every 22 miles, while the higher frequencies are put through every 11 miles.

Direct-vision television of a street scene outside the museum and of single persons sitting in a small studio in front of the same camera which can be swivelled round were naturally a great attraction to visitors. The images, after being picked up by the camera, were passed over a miniature ultra-short-wave transmitter and received by wireless, on ordinary television receivers. All the apparatus is open to the eye so that visitors were quite easy to convince that what they were seeing was real wireless television and not just a laboratory line demonstration.

As the exhibition opened long before the Post Office made the official announcement regarding the new 441-line German standard, all the non-historical exhibits operate on 180 lines.

In a brief article it is quite impossible to refer to all the exhibits of interest, but one that caught my eye was Professor Dieckmann's apparatus of 1906. Black and white drawings were transmitted and at the receiving end were reproduced on the screen of a cathode-ray tube. This little set is demonstrated, and it is astounding to think that a cathode-ray tube was employed for picture telegraphy over 30 years ago.

Book Review

The Radio Amateur's Handbook, 1938 Edition. Published by the American Radio Relay League, Inc., West Hartford, Connecticut, U.S.A.

THIS, the fifteenth edition of the handbook, contains a considerable amount of new material for, with a few exceptions, all the chapters have been revised and brought up to date. More space is devoted to receivers than hitherto, and it is gratifying to record that the information provided is very largely of a practical nature. The circuit diagrams are invariably accompanied by component values and the illustrations clearly show the layout of the sets.

The design and construction of short- and ultra-short-wave transmitting equipment is dealt with at considerable length, yet this aspect of amateur radio does not dominate the book. Non-transmitting experimenters will find much valuable information in its 446 pages.

There is a new section devoted to emergency and portable equipment, and this should provide much useful information on the design of mobile equipment for use next summer. Some five-metre sets of this kind are also described in the ultra-high frequency chapters.

The section devoted to valves has been enlarged and the tables extended to include all the new types likely to be used by short-wave experimenters.

The handbook is well prepared and very fully illustrated. Copies can be obtained from F. L. Postlethwaite, 41, Kinfauns Road, Goodmayes, Ilford, Essex, the price being 5s. 6d. post free. H. B. D.

New Apparatus Reviewed

WEARITE ALL-WAVE AC OSCILLATOR

THIS oscillator is a recent addition to the Wearite range of test apparatus and may be regarded as a companion to the portable battery-operated all-wave model that hitherto served for servicing as well as for test bench work. The AC model might better suit the last-mentioned purpose since it does not require attention to batteries.

In general the design of the two models has much in common, the only difference of any real importance being that the AC

Wearite AC mains operated all-wave test oscillator. Note spare coils shown in inset.

version has plug-in while the battery model has built-in coils.

Seven coils with hand-calibrated charts for each cover a frequency range of 100 kc/s to 19.5 Mc/s, and together include all the frequencies likely to be required for testing modern sets. There are a few small gaps in this band but they are of no consequence.

The RF output is taken from a resistance network that gives four different strengths of signals equivalent to a weak, a medium, a strong, and a very strong signal. For general testing this arrangement is every bit as satisfactory as a continuously variable attenuator and it is, of course, reliable.

A separate valve generates a low-frequency oscillation of about 1,000 c/s, and its output can be used to modulate the RF oscillator. On the other hand, it can be used independently when needed for testing PA amplifiers and AF testing generally. In addition, provision is made in this Wearite oscillator to modulate the RF from any external source.

Tests made show that the frequency calibration has been carefully carried out on all ranges, and checks made with a standard signal generator revealed that with but one exception the disagreement throughout was never greater than 1.5 per cent.

The exception was Range 7, 19.5 to 14.8 Mc/s, where the largest discrepancy was of the order of 3 per cent. The chart for this range is rather difficult to convert into condenser scale readings and could, with advantage, be simplified to read like those for the remaining six charts, which are extremely easy to convert.

This may not be a serious matter in view of the fact that the user can mark the commonly used frequencies on the condenser dial, as in addition to an engraved scale there are seven blank scales, one for each range, and on which such markings are intended to be made.

On the whole the degree of accuracy provided in this instrument is unquestionably high considering that it is a comparatively inexpensive test set.

Incidentally, we noticed a little RF leakage on the short-wave ranges, for when testing very sensitive sets a useful signal could be had without direct connection to the oscillator. Yet the unit is very well screened, as the whole is enclosed in a stout, welded-steel cabinet. Leakage at these high frequencies is extremely difficult to avoid, and then only by very elaborate shielding, which, of course, adds enormously to the cost.

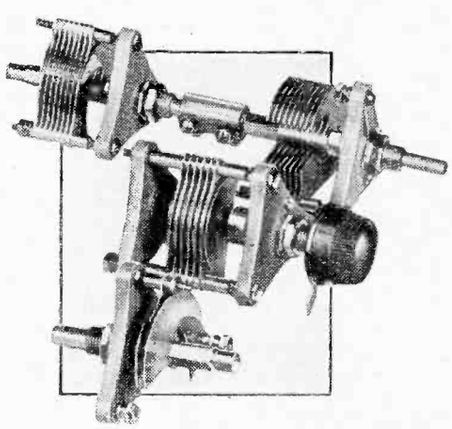
The Wearite all-wave oscillator is in all respects a high-grade serviceman's test set, and at £11 11s. is reasonably priced for an AC mains model. The makers are Wright and Weaire, Ltd., 740, High Road, Tottenham, London, N.17.

WAVEMASTER SHORT-WAVE CONDENSERS

THE Webb Condenser Co., Ltd., 32, Hatton Garden, London, E.C.1, have introduced a new range of short- and ultra-short-wave condensers mounted on ceramic plates and having an extension spindle for ganging.

The condensers for use in tuned circuits have a single end-plate only and one large bearing. The insulating plate is made of a good quality ceramic and appears to be quite satisfactory for use at the very high frequencies.

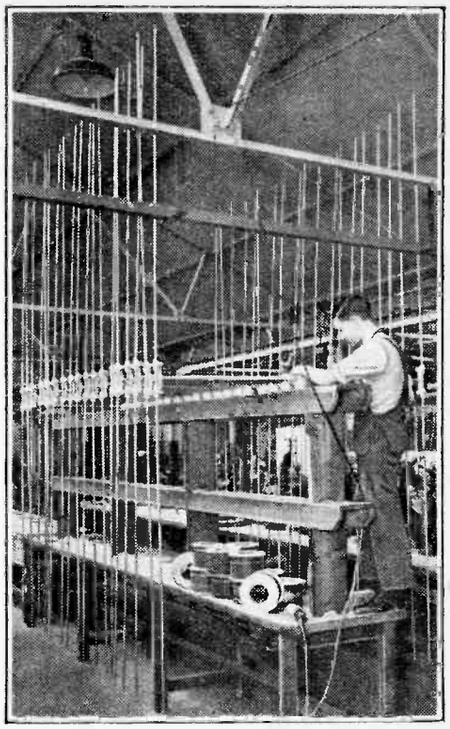
They are made in sizes ranging from 15 m-mfds. to 160 m-mfds. Tests made with a few representative samples gave measured capacities as follows: The 15 m-mfds. size had a minimum capacity of 2.3 m-mfds. and a maximum value of 12 m-mfds. One of 160 m-mfds. was found to have a minimum value of 5 m-mfds. and a maximum of 154 m-mfds. Two specimens of this size were tested and their minimum capacities were the same, but a difference of 1 m-mfd. was found in their maximum capacities.



The new Wavemaster short-wave condensers. Note the two 0.00016 mfd. models made up as a two-gang condenser

Actually this represents just over 0.6 per cent. difference only, which in a condenser of such small physical size and close spacing points to very accurate assembly work.

Prices range from 3s. 6d. to 5s. according to capacity.



TELEVISION ACTIVITY.—A batch of Belling-Lee television aerials undergoing final mechanical tests before despatch. The assembly comprises a masthead fitting, dipole and reflector.

A brass connecting piece with ¼in. hole and four 4BA fixing screws for ganging two condensers costs 6d.

Included in this series is a range of short-wave reaction condensers fitted with two ceramic plates, two bearings and a pigtail connection to the rotor. They are slightly larger physically than the single plate models as they embody a slow-motion driving mechanism giving a 10 to 1 reduction.

These condensers have a perfectly smooth action with no trace of backlash. Ideally suited for reaction control in short-wave sets they can be obtained in 0.0001, 0.00015 and 0.0002 mfd. sizes and cost 5s. 6d., 5s. 9d., and 6s. respectively.

A 0.0001 mfd. sample had a measured minimum capacity of 6.7 m-mfds. and a maximum value of 96 m-mfds. (0.000096 mfds.).

THE RADIO INDUSTRY

MARCONI-EKCO INSTRUMENTS, LTD., Electra House, Victoria Embankment, London, W.C.2, announces that increasing turnover and improved facilities have made possible substantial reductions in the price of various test instruments. As an example, RF Oscillator Unit Type TF406, previously priced at £50, now costs £35.

The firm of H. A. Hartley Company, Ltd., of Fort William, Scotland, has been formed to produce loud speakers and unit-built receiver-amplifiers. Mr. H. A. Hartley, the principal of the new firm, has long specialised in apparatus for high-quality reproduction, and he will continue to devote his activities to this field. The agent for London and the Home Counties is E. G. Wood, 2, Copthall Court, Throgmorton Street, London, E.C.2.

Pilot Radio, Ltd., of 87, Park Royal Road, London, N.W.10, has issued a new series of six leaflets dealing with the various Pilot receivers.

Listeners' Guide for the Week

Outstanding Broadcasts at Home and Abroad

THE first Christmas message of King George VI to the peoples of the Empire will be eagerly awaited by listeners throughout the world. His message will not, however, be the culmination of a "Round the Empire" broadcast, but will come at 3 o'clock in the midst of a programme of specially chosen music to be played by the B.B.C. Military Band.

His Majesty will speak from a small room adjoining the Main Hall at Sandringham House, but will not use a special microphone, as has been stated in some quarters. The two microphones, one being a stand-by, will be of the ordinary ribbon type as used in the studios; they will, however, be enclosed in the Australian wood cases which were made for use on the occasion of his Coronation message, after which they were inscribed, and will be used by His Majesty on all subsequent occasions.

FROM BETHLEHEM

ON Sunday for a short while the thoughts of National listeners will be focused on Bethlehem when, in collaboration with the Palestine Broadcasting Service, the B.B.C. relays a special programme from the vicinity of the Church of the Nativity at 5. Four microphones will be used for this broadcast, which will be transmitted by land-line from Bethlehem to Cairo and thence by beam wireless to Baldock and so to Broadcasting House for radiation from the National transmitter.

During the broadcast, which will include the Bells of Bethlehem, singing in Latin by the Choir of the Church and descriptions of the countryside, church and Grotto, will be heard a few verses from the Bible read in Aramaic, which is the nearest modern equivalent to the language spoken in Palestine during the lifetime of Our Lord.

HIS MAJESTY sitting before the two microphones, between which is the case containing the cue lights, at Buckingham Palace for his Coronation message. His message on Christmas Day will be heard from all B.B.C. stations, including the Empire transmitters, and on the television sound frequency.

KEEPING CHRISTMAS

How people in various parts of Europe are celebrating the Feast of Christmastide will be portrayed for National listeners at 9.20 on Christmas evening. Material has been collected from, among other places, Italy, Iceland, Roumania, Germany, France, Serbia and Ireland. Authentic recordings of peasant songs and carols will be included, as well as choral works by sections of the B.B.C. chorus and orchestra. This programme, which has been compiled from various sources by Igor Vinogradoff, aims at giving a survey in description and music of some of the traditional Christmas ceremonies and rites in both remote and populous places in Europe and the Mediterranean lands.

RADIO PARTY

OUTSTANDING among the light entertainment programmes of Christmas Day, especially for those who will not be enjoying the company of friends and relations, will be the two-hour radio party, which begins at 7 (Nat.). The usual round of games, charades, songs and jokes, etc., will be included in this party, which will be the first to be produced by Archie Campbell.

Artistes who will be present include Billy Bennett, Tommy Handley, the Two Leslies, Stainless Stephen, Al and Bob Harvey, Elsie and Doris Waters, Anona Winn, Alma Vane and Bertha Willmott. Members of the Variety Department will be on the stage of St. George's Hall helping to create the big-party atmosphere by joining in the games, etc.

KALEIDOSCOPIC

"ROUND LONDON AT NIGHT" is the intriguing title of an Empire programme which will be shared by National listeners on Wednesday. It was originally designed to supply entertainment news to the outposts of the Empire, but it was thought to be of equal interest to home listeners.

Six places of entertainment will be visited, each being of a different character. Each flash will be brief, but the whole will seek to convey to listeners a kaleidoscopic news bulletin of London's entertainment.

The microphone at each place will be "live," that is, the programmes will be on tap, and the compère, Tommy Woodrooffe, seated at one of the dramatic control panels in Broadcasting House, will talk about each item before he switches over to the microphone at the next "port of call."

Much depends on the radio entertainment value of the item at the moment of call, and so visits and re-visits will be made as necessary to accommodate the various items. This novel form

HIGHLIGHTS OF THE WEEK

THURSDAY, DECEMBER 23rd.

Nat., 7.30, Recital by Dale Smith (baritone). 8, Jack Payne's Party.

Reg., 8, Dame Ethel Smyth talks of her two meetings with the Kaiser before the Great War. 8.15, A concert of Christmas music. 9, Variety from the Hippodrome Theatre, Aston.

Abroad.

Naples and Florence, 7.30, Fall's operetta "The Dollar Princess."

FRIDAY, DECEMBER 24th.

Nat., 3.25, Lessons and carols from King's College Chapel, Cambridge. 5.15, Mario de Pietro and his Estudiantina. 7, "The Erring Under-Secretary"; a play for radio by Francis Beeding. 8, Kerbside Kabaret. 9.20, B.B.C. Ballroom 1909.

Reg., 8, Carol Service from St. Mary's, Whitechapel. 8.30, Music from the Movies.

Abroad.

Rennes PTT, 8.30, Christmas in Britanny.

SATURDAY, DECEMBER 25th.

Nat., 3, His Majesty the King. 6, Service from the Concert Hall, Broadcasting House. 7, Radio's Christmas Party. 9.20, "The Keeping of Christmas"; traditional ceremonies of Europe.

Reg. 4, Pantomime, "The Lamp of Al-ad-din." 8.10, Act III of Smetana's "The Bartered Bride" from the National Theatre, Prague.

Abroad.

Königsberg, 7, Humperdinck's fairy opera "Hänsel and Gretel."

SUNDAY, DECEMBER 26th.

Nat., 5, Christmas Day in Bethlehem: relay from Palestine. 8, Service from Lambeth Palace. 9.5, "Contraband": recalling the old struggle between smugglers and the King's Customs.

(Sunday, December 26th—*continued.*)

Reg., 4, Hans Schärlig and the St. Moritz Yodellers. 6.25, "Three Strangers": a play for radio adapted from the story by Thomas Hardy.

Abroad.

Munich, 6, Mozart's "The Magic Flute," relayed from the National-theater.

MONDAY, DECEMBER 27th.

Nat., 7, Children's "Monday at Seven." 8, International sport in 1937: a review of international sports commentaries. 8.30, Broadway Matinée. 9.20, World Affairs—review of the year.

Reg., 4, Ice hockey commentary. 8, Mark Hambourg and the B.B.C. Orchestra (D). 9, Act IV of Bizet's "Carmen" from Vienna.

Abroad.

Brussels II, 9, Belgian National Orchestra.

TUESDAY, DECEMBER 28th.

Nat., 7.30, Sean O'Casey's "Juno and the Paycock," relayed from Ireland. 9.20, Discussion on commerce and industry.

Reg., 6.40, Comparing Czech and Scottish bagpipes. 7.30, Dancing Through: Geraldo and his orchestra. 9, Pantomime: "The Lamp of Al-ad-din."

Abroad.

Paris PTT, 8.30, Concert from the Conservatoire.

WEDNESDAY, DECEMBER 29th.

Nat., 8.15, "Cinderella": a new setting of an old story. 10, "Round the Town": some of London's amusements.

Reg., 1.55, The annual banquet of little Londoners at the Guildhall. 8.30, "Juno and the Paycock" from Ireland.

Abroad.

All German stations 8, Special youth programme.

of entertainment, which will last for about forty minutes, will be heard at 10.

The conception and planning of this feature are in the hands of Pascoe Thornton, of the Empire Department. The staff work, both of negotiating permission and arranging for technical equipment and engineers, is a formidable task, but it is hoped the idea will yield programmes of considerable entertainment and of novelty value.

BOXING-DAY SPORT

ICE HOCKEY features in the broadcast programmes twice on Boxing Day. In the afternoon Regional listeners will, at 4, hear Stewart MacPherson describing the last period of the National League ice hockey match between the Rangers and Racers at the Empress Hall, Earls Court.

In the evening Stewart MacPherson will journey to Harringay arena to give Regional listeners a description of the last period of the Greyhounds *v.* Tigers National League match from 9.30.

"International Sport of the Year" is the title given by Michael Standing to a programme which he has compiled of excerpts from commentaries of international sporting events during 1937, which will be heard at 8 (Nat.).

Such contests will be covered as the Farr-Louis fight, Wimbledon, Test Matches, America's Cup, The Ryder Cup, the Open Golf Championship, Donington motor racing, athletics, Association and Rugby football and International title fights in England—in fact, the feature will be a cross-section of the high-spots of commentaries on the big sporting events of the year.

"JUNO AND THE PAYCOCK"

THIS great play by Sean O'Casey has now been adapted for radio by Patrick Riddell, and will be produced in the Northern Ireland studios by Peter Creswell and broadcast in the National programme on Tuesday at 7.30, and Regionally on Wednesday at 8.30. This will be the third broadcast in the series "World Theatre." The play was first produced in Dublin in 1924 and came to London in 1925, and has since had many revivals.

Juno and The Paycock (peacock) are the nicknames of two Dublin tenement dwellers around whom this tragi-comedy is written.

"KERBSIDE KABARET"

CHRISTMAS EVE round a coffee stall will be the scene set for the third edition of "Kerbside Kabaret," which will be heard Nationally on Friday at 8. It is described as London's "buskers'" own show, for it will bring to the microphone talented street musicians and singers.

THE AUDITOR.

Broadcast Brevities

NEWS FROM PORTLAND PLACE

The King's Broadcast

BESIDES the direct telephone line from Sandringham to London the G.P.O. will use an alternative route on Christmas Day to remove any danger of breakdown occurring during His Majesty's address.

Still greater numbers will tune in the Royal address this year. Normally, the method of world diffusion is by short wave via Daventry; but those Dominions and Colonies which prefer the beam service have only to inform the Post Office in order to get it.

The B.B.C. and its Revenue

WITH the news that the B.B.C. is definitely to receive a bigger allocation of money from the licence receipts, it is worth considering how the Corporation gets its revenue.

Of each ten-shilling licence fee nine per cent. is retained by the Post Office. Of the remaining "net licence revenue" 75 per cent goes to the B.B.C. and the balance of 25 per cent. to the Treasury.

In 1936 the Corporation made a net profit of about £442,000 from its printed publications. The Corporation has, of course, no share capital, and its approved policy is to find all capital expenditure out of revenue. It is interesting, therefore, to note that in recent years the revenue derived from publications has provided not only the whole of the reserves needed for new capital expenditure, but also a large part of the depreciation requirements.

Why More Money is Granted

An increase in the B.B.C.'s share of the licence revenue has been agreed in accordance with a proviso in the Corporation's licence and agreement, which says that if the Treasury should be satisfied that the income of the B.B.C. is insufficient to support its services, including Television and Empire Broadcasting, it shall be open to the Treasury to approve such increase as it may think appropriate in the circumstances.

School Broadcasts Booming

PREJUDICE against the loud speaker in the classroom is dying down, as is proved by the increase in school receivers registered at Broadcasting House. With the close of the Christmas term there are 7,000 school sets on the books, as compared with 5,645 last year.

Travel talks are the most popular, though even these have their critics. One child wrote of a talk on drought in Egypt: "It *were* dry."

Foreign Broadcasts: B.B.C. Reorganisation?

BROADCASTING HOUSE is seething under the lid on this question of foreign broadcasts. It is known that when the plans fructify there will be a general upheaval of personnel which will not be confined to those immediately concerned with foreign and Empire broadcasting.

MOBILE STATION. The latest unit of the United Broadcasting Company of America which comprises a trailer studio and a transmitter in the car. It operates in conjunction with WHK, Cleveland, Ohio, and its associated stations WCLE, WHXC and WXBN.

Coinciding with the start of foreign programmes come those impressive new appointments and transfers among the Controllers and the departure of Vice-Admiral Sir Charles Carpendale.

With Mr. Cecil Graves as Deputy Director General and Mr. B. E. Nicholls as Programme Controller the complexion of things may alter. But listeners will not worry if the programmes do not suffer.

Super-Emitrons at Circus

TWO Super-Emitron cameras will be used in combination for the first time when Bertram Mills' Circus is televised from Olympia from January 4th to 8th.

Technically, as well as from the entertainment point of view, this will be one of the most important outside television broadcasts yet attempted.

The Kensington district is known to be favourable for ultra-short-wave reception, and the engineers are confident that the transmissions will succeed.

Lighting

One of the cameras will be close to the ring, while the other, using telephoto lenses where necessary, will take in the whole arena. It is doubtful whether the normal circus lighting would have been adequate for ordinary Emitrons, but the new models should be quite equal to the occasion.

One of the most tricky jobs will be the tour of the sideshows. The handling of trailing camera cable has not yet been reduced to a fine art, so one hopes that the World's Fattest Lady and the Sword Swallower will not be caught up in its boa-constrictor coils.

Television is So Simple

ONE of the most striking descriptions of television appears in the current issue of "Women in Council," the organ of the National Council of Women.

"Television is to be fitted to all the better wireless sets in the future," says the writer. "Near the top of the case is to be inserted what appears to be a sheet of glass about ten inches by eight inches with a lamp behind it." Outside broadcasts are simplicity itself. "All the cameraman has to do as he stands on the kerb above is to turn the handle."

UNBIASED

Love's Labour Lost

THE ill-fated children's Christmas party and its wretched television demonstration which I referred to a couple of weeks ago, in these columns, has come and gone and I am left to nurse my bruises, both mental and physical. As I explained then, we were out of range of the Alexandra Palace and it had been decided to install a low-powered transmitter in one of the rooms of the parish school in which certain of the would-be Pavlovas of the village were to display their art, this being picked up on a televisor in the main hall in which the audience were to be assembled.

Unfortunately a callous and unfeeling P.M.G. knocked this idea on the head at the last moment by refusing to grant the necessary transmitting licence. Although

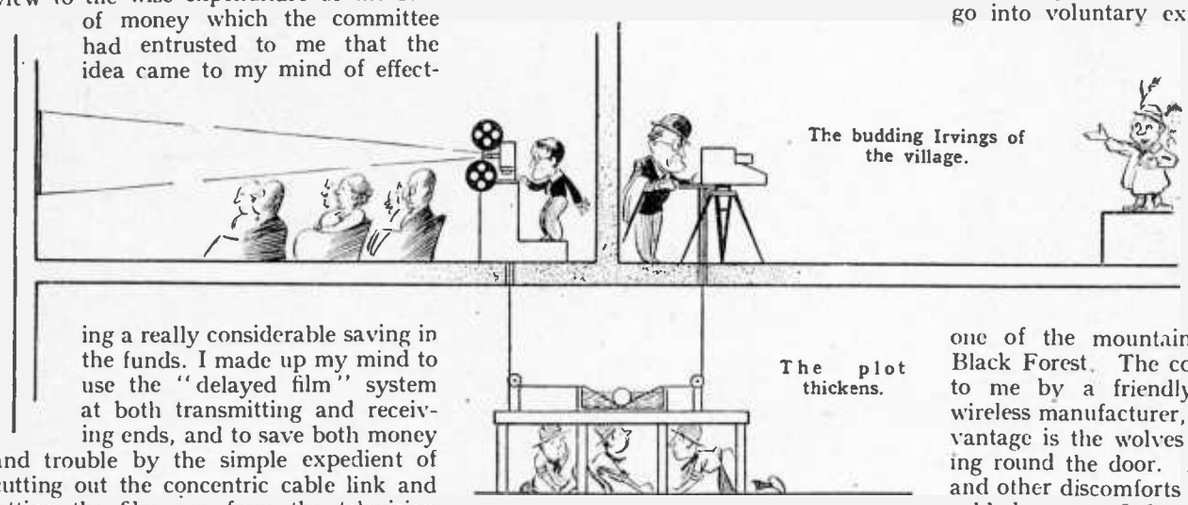
By FREE GRID

I pointed out that this was a small matter of no importance, I was overruled by the Womens' Committee appointed to organise the party, who, with their quaint Victorian ideas of right and wrong, preferred to stick to the letter of the Law rather than its spirit. The only thing that appeared to be left was a concentric cable link, and I proceeded to set about making the necessary preparations for it.

It was while I was consulting the catalogues of the big television firms with a view to the wise expenditure of the sum of money which the committee had entrusted to me that the idea came to my mind of effecting a really considerable saving in the funds. I made up my mind to use the "delayed film" system at both transmitting and receiving ends, and to save both money and trouble by the simple expedient of cutting out the concentric cable link and letting the film run from the television camera via the processing bath and under the floorboards to the projector in the adjoining hall. No sooner thought of than done, and I found it an easy matter to fix a couple of small pulleys under the floor to act as film guides since there was, I discovered, a sort of cellar or lumber room running underneath both halls.

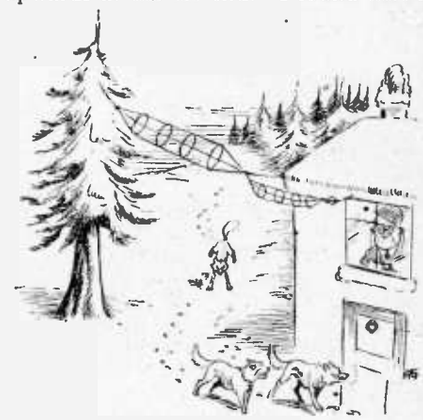
On the day appointed for the party, all went swimmingly, and there was the usual loud applause and sickening adulation of the performers on the part of the womenfolk as they recognised their relations on the screen. From a technical aspect everything was, in fact, first-class, although the same could not be said from the artistic viewpoint; but that, of course, was no concern of mine. Needless to say, I took up my stand in the transmitting hall where my presence was needed, as the projection end of the apparatus needed comparatively little skilled attention, and I left one of the little Grid leaks in charge of it. Now and again I endeavoured to introduce a spice of variety into the entertainment by resting the self-styled performers and feeding an ordinary hired professional film through the apparatus.

I suppose that the performance had been going on for the best part of an hour when—due to my being extremely sensitive from a telepathic point of view—I became aware of a feeling of unrest pervading the neighbouring hall while one of my hired films was being shown. A few minutes later my more normal sensory attributes confirmed my telepathic feelings, as a hubbub of voices broke out in the adjoining room. To my astonishment the door was flung open and the assembled audience tramped angrily out, glancing at me with uplifted eyebrows as they passed; at least the female portion of the audience did so although, judging by the gales of laughter which were coming from the adjoining hall, my efforts were appreciated at their true worth by the juvenile and adult male members of the audience who were left behind.



Naturally I stepped in to see if all was well, and one glance at the screen caused me to rush back to the other room and stop the picture. To my astonishment, stopping the film at the transmitting end did not do likewise at the other end and it was some moments before I could collect my faculties sufficiently for me to put two and two together.

When I had done so I instantly dived downstairs to the "cellar" below just in time to see its occupants, a few members of the local boy scouts troop, disappearing upwards at the far end. I found that my film coming from the transmitter on the floor above was being neatly gathered up on a reel and an entirely different one fed up through the floor to the projector. Even now I have no precise knowledge as to the actual identity of the perpetrators of this outrage, but I strongly suspect that the local scoutmaster was at the bottom of the whole business, since I heard from gossip in the village that he had not taken at all kindly to my caustic remarks about his precious aerial-erecting rocket apparatus, to which I referred a couple of weeks ago.



Wolves prowling round the door.

However, feeling was so strong in the village as the result of this unfortunate contretemps that I have been compelled to go into voluntary exile for a time and my whereabouts are unknown even to the Editor of this journal, these few notes being, of course, wirelessed to him direct. Actually I am ensconced in a humble cottage high up in one of the mountain fastnesses of the Black Forest. The cottage has been lent to me by a friendly and sympathetic wireless manufacturer, and the only disadvantage is the wolves which keep prowling round the door. Apart from wolves, and other discomforts such as the extreme cold, however, I do not feel entirely free from persecution and I have more than a suspicion that attempts are being made to jamb my transmissions. However, before closing down I would just like to say that . . . . . .

(At this point Free Grid's transmissions became completely unintelligible owing to very strong interference.—Ed.)

Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

Television

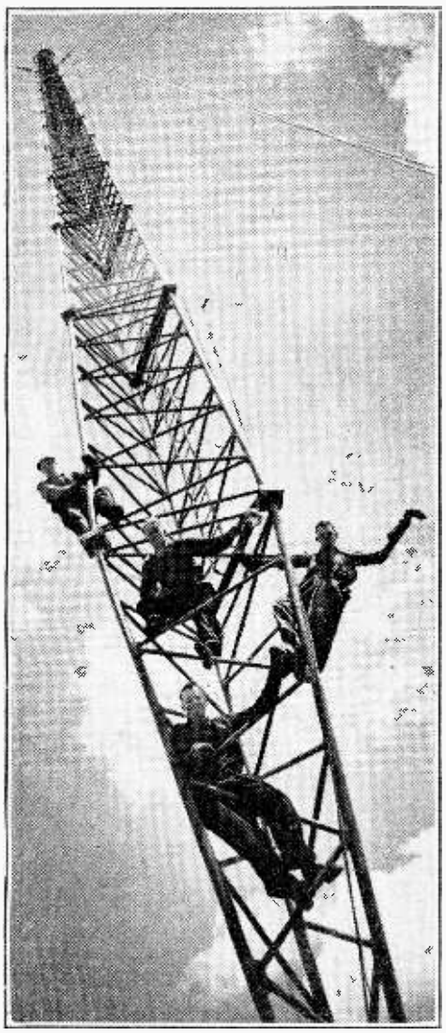
MAY I suggest that your correspondent, Mr. T. J. E. Warburton, in his keenness to prove how dense the radio critics are as to "Why doesn't television catch on?" has missed the biggest point of all, and that is limited programme material.

Who wants to buy a set costing something like 70 guineas or so and then only have a choice of one hour's entertainment during the evenings and nothing on Sundays? I ignore the one hour's transmission in the afternoon as this is not of much use to the ordinary "viewer."

I would then take for my second point the small-size screen. This is certainly a drawback in spite of what some people say. However, am I not correct in saying that experiments are proceeding apace and that a larger screen may soon be available generally? Cannot we have a definite statement from someone in authority on this point?

I think these two reasons exercise the biggest holding-back effect on television. When programmes are considerably extended in time and material of the right entertainment value, and a somewhat larger screen available, I feel pretty certain that television will then forge ahead.

Henlow. J. K. HARE.



NEW VERTICAL MAST RADIATOR of KDKA, the well-known Pittsburgh transmitter, is 718 ft. high, weighs 60 tons and is supported at its 18 in. base by a single porcelain insulator. The picture shows the riggers on their way down, having finished the construction. No wonder they look happy; two months ago the original mast buckled and fell when it reached a height of 644 ft. Working on a wavelength of 306.1 m., with a power of 50 kW., the station celebrates its seventeenth anniversary this year.

I HAVE previously refrained from making any comment on television policy, fearing to be a lone voice in the matter. Now the subject has been broached I must add my vigorous and wholehearted support to the comments of your correspondent, Mr. T. J. E. Warburton.

Practically speaking, nobody wants television as a broadcast entertainment. It is just a psychological matter. This lesson should have been learnt from the B.B.C. Fultograph picture transmissions years ago.

So far as it went, this service was very fascinating to watch and reliable in operation. What was the attitude of the non-technical public? Just an interesting novelty to be viewed once, like an exhibition piece!

Television is very much in the same category. Broadcast sound is the mental soporific necessary to counteract the wear and tear of modern life. Its absorption requires little or no effort. More often than not, it is used as accompaniment to some other occupation or relaxation.

Television requires concentration all the time. It is fundamentally unsuitable for the purpose to which some interests wish to force it.

A very strong protest is long overdue against any more listeners' money being spent on this white elephant.

Norbury. B. S. T. WALLACE.

I AM sorry that your correspondent, Mr. Warburton, should imagine that the very obvious point which he mentions as an obstacle to television development has escaped the notice of radio critics. But I am still more grieved at his glib acceptance of that abominable theory that radio is, and should be, nothing more than a dribbling background to other occupations. Any radio programme which is in the smallest degree thought-provoking, and on which considerable time and effort have been expended is worthy of the whole attention of the listener. It is, in my view, most unfortunate that a new generation should be encouraged to attempt to do two or three things at once and nothing properly.

Those programmes which only provide "background" listening seem to me to be mere noise and not worth broadcasting at all.

It is very singular that as each new invention comes along there is a majority of people who cannot see that one day it will enjoy the most widespread popularity. To take a few examples this applied in turn to the telephone, the gramophone, the silent film and the talking film, and now to coloured films and television.

If I in my turn may be allowed to dog-

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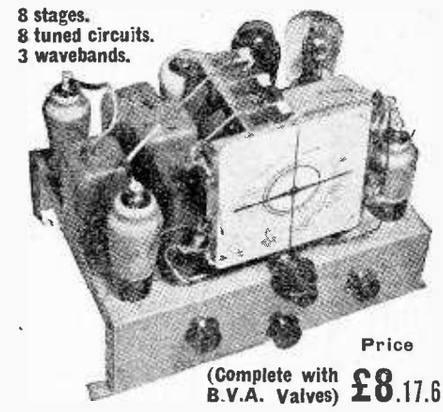

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Performance (made possible by use of multi-electrode valves) equal to that of many receivers employing 8 valves or more. Brief specification includes: Large "Airplane" dial, with different coloured lights automatically switched on for each wave-range. Micro-vernier 2-speed drive. 4-point wave-change and gramophone switch. Volume control and variable tone control also operative on gramophone. Reinforced heavy-gauge steel chassis. Covers 19–2,000 metres.
Circuit comprises. Preselector circuit, radio frequency amplifier (operative on all 3 wavebands), triode-hexode frequency changer, double band-pass I.F.T. coupled I.F. amplifier, double diode-triode detector and L.F. amplifier. D.A.V.C. applied to 3 preceding valves. 3-watt pentode output.

9 VALVE FOUR-WAVE SUPERHET DE LUXE

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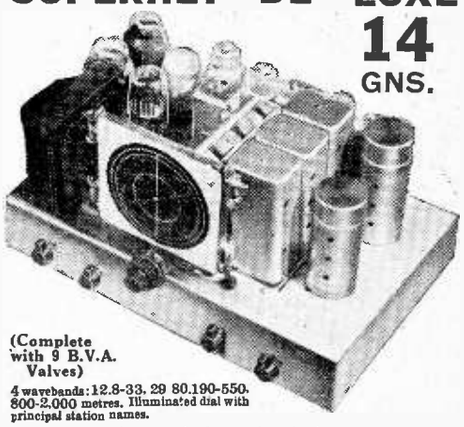

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Letters to the Editor—

matise, the whole trouble is that television is not perfect. It is very nearly perfect, admittedly, but still not perfect. When television has finally been perfected then I think we shall see it in millions of homes, but in the meantime I implore Mr. Warburton not to encourage or tolerate "background" listening by word or deed.

L. MARSLAND GANDER.

London, S.W.13.

I SUGGEST that Mr. Warburton may have chosen his words carefully enough, but has not edited his theories sufficiently; his whole letter appears based on a misconception, viz., that television is intending to introduce into the home a complete twelve-hour cinema performance for 365 days a year.

Can we not approach it from a different angle, covering each point raised by Mr. Warburton?

Television should provide sound plus vision. A time can be visualised when every receiver has a screen attached, but the screen need not be illuminated when the sound receiver is switched on. Listeners will still be able to enjoy an hour of Sir Thomas Beecham or Mr. Harry Davidson, according to their taste, with the screen darkened, but it will surely not be a disadvantage that they can switch on the tube to see what the new composition of their favourite orchestra is! Then they may still carry on their normal occupation, as suggested, and enjoy just listening. Most good listeners having chosen the item to which they wish to listen sit down and devote their attention to the item in question; it is to be hoped that good viewers will only switch on their tubes when they wish to devote time to a section of the programme.

The size of the screen will be a matter of choice and circumstance, but I admit a leaning towards the compact detailed television picture, say 20in. × 16in. for the intimacy of the drawing-room and two or three viewers.

The number of valves, Mr. Warburton, is not preposterous, but necessary; the increased demand will possibly enable manufacturers to effect still further reductions in price.

To conclude, please, Mr. Warburton—and in your name I appeal to all those who share your views—do not regard television as a home cinema, but as your beloved sound broadcasting, plus the glorious possibilities of vision, and that by its very nature it will add to the almost world-wide popularity that sound broadcasting now enjoys.

"ENTHUSIAST."

Gidea Park.

Spark Interference

IN these enlightened days of frequency stabilisation and hair-splitting over a few cycles it often comes as a very unpleasant surprise that we still have with us a few hardy members of an old stock who scorn such new-fangled devices as modulated carriers and crystal control. Most of your readers who are accustomed to look for entertainment on the higher wavelengths of the medium broadcast band cannot but have noticed the extraordinary amount of interference that exists at times due to the attentions of a number of spark stations, working (?), apparently, on wavelengths of above 500 metres. Here, in Chelmsford, at times, the interference spreads up the band often as far as North Regional. The entertainment value of stations above 450 metres is, at such times, nil. The offenders are, in the main, spark stations situated on ships, and the trouble is more marked during daylight hours. I wonder if any of your readers have a similar grumble—or is the trouble peculiar to the East Anglian district?

CHRIS. P. FAGAN, B.Sc.

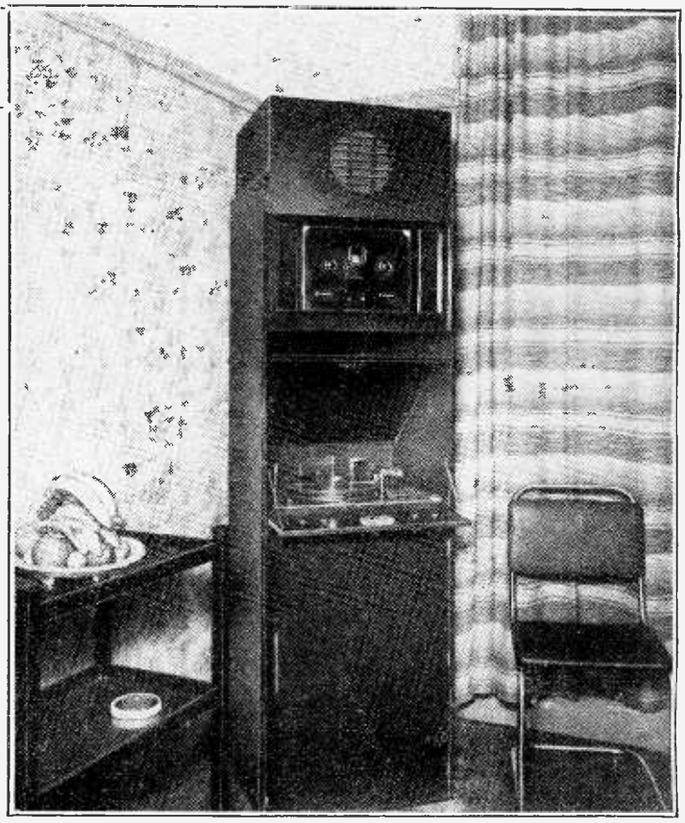
Chelmsford.

Housing the Receiver

I WAS much interested by "Cathode Ray's" description in *The Wireless World* of October 22nd of Mr. Ewart Puddicombe's broadcast receiver and venture to send a description and photographs of my own equipment.

My unit, although having nothing in common with Mr. Puddicombe's justly praised design, was, nevertheless, planned with some thought and care to suit rather different requirements.

As the lady of the house is the chief user, I studied her habits and found that she rarely desired to sit down while tuning-in, but preferred to have the controls at such a height that she could manipulate them comfortably while standing up and then proceed with such household tasks as did not interfere with the enjoyment of the programme. Another reason for choosing this elevated position for the receiver unit was to keep controls out of reach of small children.



"My Home Set." A readers design.

The receiver proper is pushed in from behind so that when improvements are thought desirable it is merely necessary to remove one chassis and push in a new one ready for work. A small but important point is that the panel is attached to the chassis in such a way that the whole can be removed in a matter of minutes without having to take the knobs off. This method is equally suitable for the home constructor or the manufacturer.

Above the receiver is the loud speaker with power unit and push-pull output stage; this seldom requires alteration; it does, however, slide out from behind, complete with speaker and baffle, if necessary. The speaker above the set is really a monitor only, but provides adequate volume for the living-room where the set is located. The chief speaker is located in the lounge hall and has an infinite baffle constructed by building a door at the foot of an otherwise enclosed stairway and placing the baffle of the main speaker above this door; thus when the door is closed the back is entirely cut off from the front. This provides up-to-date "central speaking" for a house of the small semi-bungalow type, and permits the aforementioned household activities to be carried on anywhere to the accompaniment of an appropriate broadcast.

If the broadcast programme does not meet the case, it is only necessary to open the door of the compartment containing the record-playing equipment. This is mounted at a convenient height for putting a selection of records on the Garrard automatic changer.

The vacant space in the centre is used for a short-wave adaptor which is lifted from the lower compartment when required and stood on the shelf formed by the lid of the gramophone compartment. It is obvious that the gramophone and adaptor will not be used simultaneously. The adaptor is generally operated from a sitting position, and for this it is at just the right height. The lower compartment houses records and other small items which may be used from time to time.

C. H. CAMPBELL GRAY.

Glasgow.

Resistance v. Transformer Coupling in Push-Pull Amplifiers

IT is a curious thing that, as soon as someone says or writes the word "transient," we, some of us, get all hot under the collar. Whilst I would not say that I am in that state, I do feel it incumbent on me to deny the soundness of Mr. Cotterell's opinions given in his letter in your issue of December 9th. It may be, too, that your readers will be interested in the results of a considerable number of practical experiments I have carried out during the last few months.

Mr. Cotterell's opinion that a transformer-coupled output stage is preferable to one resistance-coupled was held by me for

Letters to the Editor—

many years, and finally rejected some two or three months ago. In common with many others, I believed that the reproduction of a transient was almost entirely dependent, so far as the amplifier was concerned, on a wide, flat frequency response, since we were quite convinced that comparatively small phase displacements were not audible; furthermore, peak voltages likely to overload the output valves and cause grid current to flow would not be so unpleasantly reproduced on a transformer-coupled amplifier.

And then came this chilling statement in Dr. Hughes' thoughtful letter in your issue of September 10th: "The well-known effect in coupling transformers which reduces the so-called attack in reproduction is due to the large number of cycles which are essential for a substantial change in the excursion of magnetisation. Amplitude distortion can account for effects hitherto associated erroneously with phase." Now it so happens that at the time the transient discussion was raging I was engaged on designing some new apparatus intended to give a very high degree of fidelity of reproduction, and, in accordance with my old beliefs, I had included a properly loaded intervalve transformer in the amplifier. Dr. Hughes' letter, with its basic assumption that transformers *were* inferior, caused me to stop and consider, and I borrowed a *Wireless World* Push-Pull Quality Amplifier.

My speaker was known to be good on frequency response and transient reproducing properties; so I started a series of comparative tests, with the result that I believed there was an improvement in transient reproduction when using the *Wireless World* amplifier. I also came to the conclusion that recent improvements in valve design coupled with advances in technique might enable me to construct a still better amplifier, and after some considerable experimental work I evolved an amplifier devoid of iron, and in which considerable attention was paid to the eliminating of harmonic distortion. Briefly, it consists of a no-gain phase-inverter feeding two triodes in push-pull, which, in turn, are resistance-coupled to two 6L6 beam-power tetrodes, working in pure class A, and with negative feedback to cancel out odd harmonic distortion. The output power, with a total analysed harmonic distortion content of less than 3 per cent., is 13.8 watts, and the sensitivity of my speaker is such that overloading of the output stage does not have to be contemplated. Phase distortion, whether it is audible or not, was found to be very small. The frequency response can be made as wide and as flat as one may desire.

I then constructed an amplifier with the same types of valves in the output stage, but this time coupled to the preceding stage with a loaded transformer. Again negative feedback was used, and the valves were used in pure class A. I then instituted a series of tests with the help of several observers, some musically minded, some technically minded, and some—just ordinary listeners. In choosing broadcast programmes for test musical items were specially sought which had repetitive passages (and if one has a fairly comprehensive musical knowledge such compositions are not hard to find). Now, I make no claim to these tests being comprehensive, but as I was anxious that the apparatus which I ultimately proposed to produce should be as free from distortion as possible, I did most certainly approach the tests with an entirely open mind, and my observers did not even know to what they were listening. They were given instantaneous change-over tests on the one speaker, and were asked to record their impressions.

The results were unanimous in that for "cleanness" of reproduction and fidelity of transient reproduction the all-RC amplifier won quite comfortably. Also, in spite of the greatest care, I was unable completely to eliminate hum with the transformer-coupled amplifier, whereas the RC amplifier on full gain with the aerial disconnected from the radio unit was *completely* silent, even with one's ear stuck right into the speaker.

An interesting sidelight has appeared as a result of these tests. I have mentioned that "just ordinary listeners" were asked to co-operate, *and it has to be remembered that these people were asked to listen to reproduction which had no attenuation below 10,000 cycles.* For years it has been stated that the ordinary listener "doesn't like top"; I have always thought that he would like nice top, but, not being particularly interested in so-called "high-fidelity reproduction," he would rather do without top than have harsh or shrill top. Each one of my "ordinary listeners" was very considerably impressed with the analytical quality and "atmosphere" of the reproduction, but I nearly had a fit when more than one, with every evidence of enthusiasm, said it was so *mellow*! Once upon a time, someone coined the phrase "high-fidelity" to distinguish reproduction which was a sensible approach to realism; we all know that the label has been attached to every kind of reproduction, so that nowadays it means nothing at all. On the other hand, we have come to associate the word "mellow" with the sort of noise a cheap set makes. Can it be that a term of obloquy will become one of respect, and what would be the reactions of the public if I advertised "the first *really mellow set* that has ever been offered"?

Fort William. H. A. HARTLEY.

Television and the Post Office

THE editorial comment in your issue of November 11th seems to suggest that the Post Office may be tempted to take over the whole radio industry simply in order to secure an economical (?) method of distributing television programmes.

In my opinion television has very little connection with sound broadcasting, as, even under the most favourable conditions possible, it will remain very much more expensive. Even with "wired television," a complicated receiving apparatus would be required, and this would presumably have a cost comparable with a present-day vision receiver. Relay services, on the other hand, provide subscribers with "sound" programmes without the use of any receiving apparatus other than a loud speaker.

Surely it would be extremely dangerous to prejudice the present radio industry in order to encourage uneconomically the television principle which has so far failed to arouse any substantial public demand.

St. Annes-on-Sea. JOHN MUSCUTT.

The British Sound Recording Association, the address of which is 44, Valley Road, Shortlands, Kent, has published the first issue of a journal to be devoted to the activities of the Association. The first issue is in typewritten form, and contains articles on various aspects of the subject.

A Seasonable Thought...

IN 1906 the custom was to "light the tree" with candles. Today candles make way for festoons of electric bulbs... such is progress.

★

In 1906 T.C.C. made their first condenser. Today's T.C.C. condensers are something far removed from the types of 30 years ago—that too is progress.

★

Yet progress cannot change the spirit of the festive season and so T.C.C. wish all friends, past, present and future

A MERRY XMAS

★

T.C.C.

ALL-BRITISH CONDENSERS

THE TELEGRAPH CONDENSER Co. Ltd.
Wales Farm Road, N. Acton, W.3

GA 3666

Random Radiations

By "DIALLIST"

More and More Listeners

ONCE more the wireless licence figures make amazing reading. For October there was a marked slowing down in the rate of increase as compared with the same month in 1936. The Dismal Jimmies were not slow to predict that for the future the increase would become less and less as month followed month. They forgot that we had a phenomenally fine and warm October this year—a real St. Martin's Summer. Anyhow, they are confounded by the November licence figures, which show a rise in the number of licences of no fewer than 53,152, which more than offsets the October slowing down. Taking the two months together we have a total increase of 84,290, or an average of 42,145. For the 12 months to the end of November, 1937, the increase was 526,682. The total is now 8,424,200, and there is every likelihood that the eight and a half million mark will be reached early next year. It is interesting to note that, apart from new licences, there were 955,432 renewals in November, nearly one-ninth of the whole number in force.

"Diallist" Wants Big-screen Television

SO far I have not been able to see with my own eyes the results of either of the big-screen television processes that are now to the fore. I hope, though, to attend a demonstration of one of them within a day or two. Personally, I am convinced that the future success of television as a general hobby is closely linked up with the bigger image. No matter what perfection you achieve in steadiness, in definition or in illumination with the small screen, the man in the street is not particularly attracted. He wants something that he can see easily without having to approach within a few feet of the instrument, something that is, so to speak, the visual equivalent of the loud speaker. The small screen imposes much the same limitations as did the head-'phone set. In the old pre-loud speaker days, when some of us had two or three pairs of 'phones connected to the receiver, friends who wanted to listen had to group themselves round the wireless table. The coming of the loud speaker made it possible for them to sit comfortably about the room in armchairs. When television enables them to see in the same kind of way it will go ahead by leaps and bounds.

The Variable Selectivity Boon

THE advantages of variable selectivity for broadcast reception under modern conditions have long been preached in *The Wireless World*. Probably, though, comparatively few people outside the ranks of those who strive for the highest possible quality in reception had ever handled a receiver containing this feature until the present season. In past years there have been high-priced sets whose selectivity was variable, but this year there are quite a few within the £20 limit. Listeners at large are thus beginning, slowly it may be, to realise the advantages of variable selectivity. I say slowly because it is surprising to find how few of the uninitiated ever take the trouble to *try* to tune a set properly—or even to read the simple instructions given in the handbook that accompanies it. Time and again I have found friends who had invested in a good set with variable selectivity listening to the local station with the set in its most selective conditions and quite unconscious of doing anything wrong.

Weeding Out Our Valves

WHEN it published those astonishing lists of valves and valve data that it gave us last month *The Wireless World* heaved an editorial sigh over the vast numbers that must be dealt with nowadays when anything of the kind is done. Nine hundred types on the British market! The thought is staggering. The number takes into account, of course, the products of many firms. In some cases what is virtually the same valve (though it is sure to have a different name) is made by several firms. Still, when all is said and done, when you boil down existing valves to the smallest possible number, the total runs to hundreds. Isn't it high time that the lists were weeded out and that makers decided to produce only the valves that are really needed? You can't, naturally, suddenly take right off the market valves used in sets only two or three years old: if you did you would make it impossible to re-valve such receivers and therefore render them useless and worthless. But I don't see why definite and reasonable dates should not be given, some time in advance, for the complete cessation of supplies of obsolete and obsolescent types. This would automatically solve the problem of weeding out those ancient sets that are an insult to modern transmissions.

Getting on With Less

AT present, I feel, the set designer has before him far too wide a choice of valves. Instead of having to adapt his circuits to a limited number of available valves, he can go on trying valves of different makes, which are really only variations on the same theme, until he finds one that fits into his circuit. It would be a far, far better thing if his choice were more limited. His problem would then resolve itself into this: the number of valves from which I can choose is small; they are all thoroughly efficient; knowing their data, as I do, my brains and my mathematics should enable me to evolve circuits that will obtain excellent results from them; let's get down to it! And this is no mere visionary ideal. Several of our firms this season are using British made valves of American type in all their mains receivers. And very good receivers they are. Yet only about 35 kinds of American valves are made by our manufacturers. If you can produce a variety of good mains sets, large and small, from a selection of but 35 types of valve, it looks as if our absurd numbers could be reduced rapidly and with no great loss to anyone.

We Must Standardise

IN point of fact the gains would vastly offset the losses. We could probably rub along very well with about 100 different valves altogether, including battery valves, AC mains valves and AC/DC valves. It would, though, be essential (*a*) that a common system of nomenclature was adopted, and (*b*) that all valve-makers turned out a range of valves with the same characteristics. These things have been done in the United States, I believe. A best-grade 6A7 there *is* a 6A7, no matter what its percentage. You don't have to look up a "list of equivalents" to discover that maker A's XYZ.43.QC corresponds more or less with maker B's ABC/P/P/3a. I imagine that, as time goes on, the American, or International type of valve will become the standard. Well, let's see that time goes on quickly and that standardisation is achieved as soon as possible. But there must be no tomfoolery as, unfortunately, there is now, about this valve in one maker's list being *very nearly* the same thing as that valve in another's. Standardisation and reduction of numbers would mean lower manufacturing costs, and, therefore, those cheaper valves that have for so long been the crying need of wireless in this country.

Physics For All

HAVE you come across that delightful book, *You and the Universe*, by Professor Paul Karlson, of Berlin? It is the English version of his *Du und Die Natur*, very well translated by Bernard Miall. Professor Karlson may be described as the Jeans of Germany, for he possesses the same happy knack of making difficult things understandable, and he is even fonder of simple analogies. The delightfully humorous pen-and-ink sketches which illustrate the book assure the reader the moment he opens it that he is not going to find it dull. And he doesn't! Many readers of *The Wireless World* are deeply versed in modern physics and they will probably be critical, particularly of some of the analogies—perfect analogies are pretty rare. But I think that they, as well as the less erudite, will find *You and the Universe* good reading, and I am sure that some of the ways in which abstruse matters are approached will prove useful when friends who don't know the first thing about physics (we all know those friends) ask for those simple explanations which are usually so difficult to give.

Right Up to Date

Though it was first published in German in 1934, *Du und Die Natur* is more up to date in many ways than any of the other books dealing with physics in a popular way that I have so far come across. It is, for example, particularly happy in dealing with those comparative newcomers, the neutron and the positron. There are unusually fine photographs showing the paths of both. Another very impressive photograph, by Dee of Cambridge, shows the splitting of a heavy hydrogen atom into light hydrogen and a new and still heavier hydrogen. Then I am sure you will like the way in which Professor Karlson deals with things so dark to the mind of the ordinary man as quantum mechanics, matrix mechanics and wave

Random Radiations—

mechanics. You'll be pleased, too, at the extraordinary fairness of his outlook. In some foreign books one finds a tendency to ascribe all discoveries of importance to natives of the author's own country and to minimise the work done by scientists in others. Rutherford is one of Professor Karlson's heroes, and he pays full tribute to the work of Clerk-Maxwell (except that he misspells his name "Clark"), C. T. R. Wilson, Dirac, Hamilton, and many other British scientists, as well as to their confreres in the United States, in Holland, in France, and in other countries. In a word, it's a well-written, well-informed book which I am sure you'll like if you read it.

Television in America

AMERICANS are getting all "het up" over television services. When are they going to start? Who's going to be first to start them? Experimental work has been going forward for some time on various 441-line systems. There are two plants in New York, on the tops of the Chrysler and the Empire State Buildings respectively, and there must be another half-dozen or so in Los Angeles, Philadelphia, and other parts of the country. The latest report is that both the Columbia and the National Broadcasting systems will be ready to give a regular service when the World's Fair opens in New York the year after next. It seems likely that the 441-line standard will be adopted throughout the country, for, though this hasn't been made the official number of lines, all experimental work appears to be conducted with 441-line apparatus.

Plaints from the West

SEVERAL grouses reach me about the poor reception of West Regional station in the more southerly parts of Devon. Not merely do its transmissions fade, but they suffer also from that particularly hateful form of fading in which horrible distortion occurs as the signal approaches its lowest level. With ordinary fading, provided that the signal is strong enough at normal level to leave a good reserve of amplification in hand, efficient automatic volume control can deal pretty well. But the distorting type has the best of AVC beaten. West Regional has not proved a very successful station, for the size of its service area towards the south and south-west has always been on the small side. I remember having some misgivings when the site of the station was first announced and I looked it up on the map. Some of the highest ground of Exmoor and Dartmoor lies between it and the south of Devonshire. The opening of the Start Point transmitter will indeed be a boon and a blessing to dwellers in those parts.

No Precedent For This

THE coming of the foreign radio manufacturer into the market for really high-grade receiving sets creates an extraordinary position. In many other industries Britain has suffered from (or some would say, gained by) foreign competition. But always, hitherto, the foreigner has introduced the cheap or medium-priced mass-produced article. The British manufacturer has been able to keep both his end and his flag up by the very fact that he produced the best. Whether you think of motor cars, or sporting guns, or cutlery, or glass, or cloth, or china, or footwear, you can't get away from this. Britain, in a word, has the name for producing goods of the finest class, which sell the world over for their intrinsic and their lasting qualities. And now we are faced by the fact that the luxury wireless set (backed by a five-year guarantee) is to be made in Britain right enough—but by American firms. If only our radio manufacturers had heeded the exhortations and the warnings that have appeared in *The Wireless World* for a good many years now, people in this country and in the Empire would be saying, as they do about other products, "If you want the very best, buy British; it may cost a little more, but it has the performance and it does last." There's still time for the old saying "British is best" to be true once more of wireless if only our people will awake to the realities and will cease to allow the ground to be cut from under their feet.

Television Programmes

Vision 45 Mc/s. Sound 41.5 Mc/s.

THURSDAY, DECEMBER 23rd.

3, Tommy Handley and Company in "The Disorderly Room." **3.15,** "Little Red Shoes": a Hans Andersen story. **3.25,** British Movietonews. **3.35,** "Close up": a little show. **3.55,** Noni and Partner.

9, Marcel Boulestin will discuss Polite Wine-Drinking. **9.15,** Gaumont-British News. **9.25,** "Hänsel and Gretel": a masque to the music of Humperdinck.

FRIDAY, DECEMBER 24th.

3, Coffee Stall: a light entertainment. **3.20** Gaumont-British News. **3.30,** Jack Payne with his band.

9, Irene Prador in songs. **9.5,** ". . . drew the pictures." **9.20,** British Movietonews. **9.30,** Jack Payne with his band.

SATURDAY, DECEMBER 25th.

3, The Rev. Pat McCormick. **3.5,** Irene Prador in Viennese songs, and Russell Swann. **3.20,** Gillie Potter. **3.30,** Cartoon film. **3.35,** "Alice in Wonderland."

9-10, Stars of Yesterday and To-day in "Music Hall Cavalcade."

MONDAY, DECEMBER 27th.

3, Cartoon Film. **3.5,** "Hänsel and Gretel": a masque to the music of Humperdinck. **3.55,** British Movietonews.

9, Irene Prador and Russell Swann. **9.20,** Gaumont-British News. **9.30,** "Dick Whittington and his Cat": television's first grand Christmas pantomime.

TUESDAY, DECEMBER 28th.

3, Russell Swann. **3.10,** Lisa Minghetti (violin) with the Television Orchestra. **3.20,** Gaumont-British News. **3.30,** "The Old Lady Shows Her Medals": a play by J. M. Barrie.

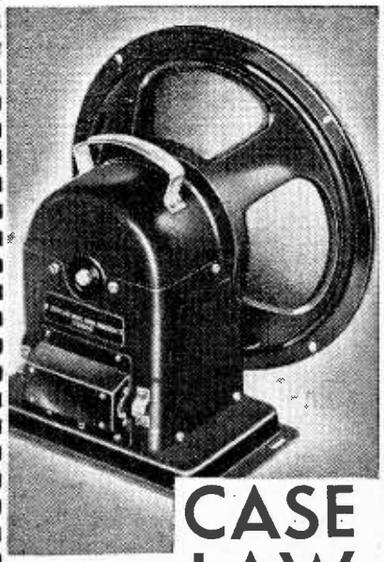
9, Variety act. **9.10,** British Movietonews. **9.20,** "The Ghost Train," the thriller by Arnold Ridley.

WEDNESDAY, DECEMBER 29th.

3, Christmas Cabaret with The Western Brothers, Harry Hemsley, Texas Tommy and his Wonder Pony and The Three Nagels (foot balancing). **3.20,** British Movietonews. **3.30,** 107th edition of Picture Page.

9, Christmas Cabaret: details as for 3. **9.20,** Gaumont-British News. **9.30,** 108th edition of Picture Page.

POINTS OF IMPORTANCE in the Rola G.12



CASE LAW

When a Judge delivers a legal decision he does far more than settle the immediate point at issue—he sets a standard by which similar cases will in future be judged. When Rola designed the giant Rola G.12 they did far more than make "just another speaker." They set a standard, an entirely new standard, of performance and quality by which the radio connoisseur has come to judge all other reproducers. To-day the Rola G.12 is still unequalled but we have no wish to sing its praises for the G.12 is a unit that can speak for itself. So formulate your own verdict.

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Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section.

SHORT-WAVE SIGNALLING

RECEIVERS for ultra - short waves cannot be made so selective as those designed for medium-wave reception. To overcome this drawback it is proposed to use a double system of modulation. The ultra-short wave is first modulated with a wave of medium length, and the latter is then modulated with the speech or other signal to be transmitted.

For reception a superhet circuit is used. The ultra-short-wave carrier is fed from an untuned aerial to the first detector stage. This rectifies out the medium-length carrier-wave, which can then be separated by the highly selective IF circuits from other short-wave transmissions which would otherwise overlap each other.

C. Lorenz Akt. Convention date (Germany), December 13th, 1935. No. 470547.

o o o o

REMOTE TUNING CONTROL

A WIRELESS receiver is tuned from a distant point by a series of impulses sent through a dialling switch of the kind used for making automatic telephone calls. The first set of impulses passes through a magnet coil M, which vibrates an armature A which for the sake of simplicity is shown as carrying only two pawls P and P1. Two cams, C, C1 on a shaft S1 are so arranged that the pawl P is operative but not the pawl P1. Impulses sent will now cause a ratchet wheel R, which is mounted on the tuning condenser shaft S, to be rotated by the pawl P, against the action of a restoring spring B.

When the first series of impulses is completed, a "clearing" impulse operates a magnet M1 to rotate the shaft S1, so that the cam C1 allows the pawl P1 to engage the ratchet wheel R1, whilst the pawl P is lifted out of contact with the wheel R.

The next series of impulses then allows of a "fine tuning" adjustment as follows :— The wheel is rotated by the pawl P1 to lift an arm A through a cam C2. This movement drives a pawl P2, which in turn drives the wheel R one-tenth of the distance through which it is driven by one of the first series of impulses.

Standard Telephones and Cables (assignees of Le Material Telephonique.). Convention date (France), February 8th, 1936. No. 470736.

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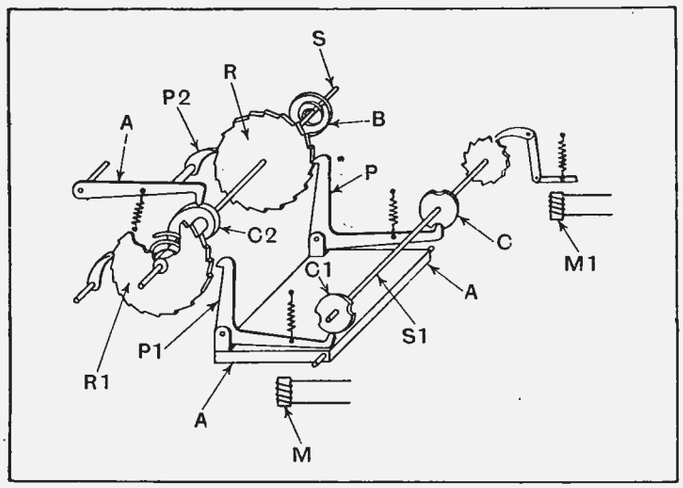
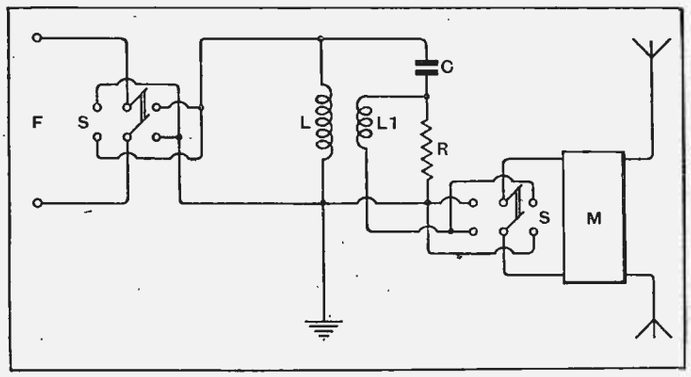


Mechanism for tuning a receiver by sending impulses along a line from a distant point.

PHASE-CONTROL CIRCUITS

ACCURATE changes in phase are produced, without any substantial alteration of amplitude, by the circuit shown. The inductance L is shunted by a condenser C in series with a resistance R, all being across the feed line F. By varying the condenser C a phase-shift up to almost 180 deg. can be introduced, which can be doubled by reversing the switch S. The switch may be inserted at either of the two points shown in the Figure.



Circuit for producing alternating voltage of controllable phase and constant amplitude.

The load is indicated at M. It may be an aerial when the arrangement is used for transmitting phase or frequency modulated signals. The supply voltage can be halved at the output by coupling a coil L1 to the coil L, the mutual inductance between the two being half the self-inductance of the coil L.

Marconi's Wireless Telegraph Co., Ltd. (assignees of W. van B. Roberts). Convention date (U.S.A.), November 9th, 1935. No. 470543.

o o o o

FREQUENCY-MODULATED SIGNALS

IN the ordinary way, frequency or phase modulated signals are rectified by first converting them into an amplitude - modulated carrier, which is then fed to a square-law detector.

As an alternative scheme, the signals are fed to a multigrid detector, one grid of which receives the signal direct, and the other after it has passed entirely or partly through a retardation network which introduces a phase difference of 180 deg. In this way design is simplified without losing any of the advantages of the known method of using two push-pull detectors in order to avoid second harmonic distortion.

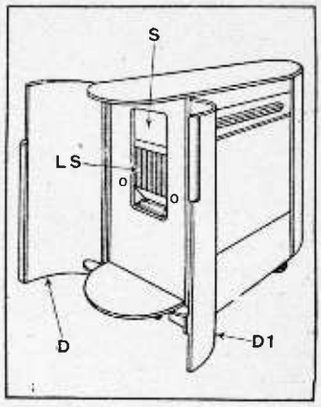
Marconi's Wireless Telegraph Co., Ltd. (assignees of M. G. Crosby). Convention date (U.S.A.), June 6th, 1935. No. 470131.

o o o o

TELEVISION SETS

THE drawing shows a cabinet designed for a combined sound-and-picture receiver. It is specially shaped to take the cathode-ray tube, which is mounted in the upper part and throws the picture on to a screen S. The loud-speaker grille is fitted immediately below.

The two side doors D, D1, together with the projecting part of the lid, serve to shield the screen S from external light when receiving broadcast pictures. When the side doors are closed, the cabinet presents a neat and symmetrical appearance, with the control knobs hidden out of sight, and is, therefore, likely to harmonise with the existing furniture in any room.



Design of cabinet for a television receiver.

Ideal Werke Akt fur drahtlose Telephonie. Convention date, March 14th, 1936. No. 470623.

o o o o

TIME-BASE CIRCUITS

SAW-TOOTHED oscillations for controlling the movement of the scanning beam in a cathode-ray television receiver are generated by a screen-grid or pentode valve having resistance-shunted coupling coils between the anode and control grid. The frequency of the oscillations is controlled by varying the anode voltage, and synchronising impulses are applied to the control grid.

The usual method of back-coupling a multi-grid valve produces an oscillation of approximately symmetrical shape, but the circuit, according to the invention, gives a true saw-toothed wave form, having a steep rise followed by a gradual fall.

Telefunken Ges fur drahtlose Telegraphie. M.V.N. Convention date (Germany), December 20th, 1934. No. 470752.

o o o o

CATHODE-RAY TUBES

IT is usual to make the bulb of a cathode-ray tube by blowing from the molten glass, but it is difficult to obtain in this way the uniform thickness and perfect contour that is essential to prevent optical distortion, either of the projected picture in reception, or of the picture which is focused on to the mosaic cell electrode in a cathode-ray transmitter of the Iconoscope type.

The remedy, according to the invention, is to make the part which requires to have a good optical surface in a glass moulding press as a separate operation, and then to fuse this part on to the blown-glass portion of the tube. The result is an economical combination of a glass envelope with screen or window parts of high optical fidelity.

Corning Glass Works Corporation. Convention date (U.S.A.), July 18, 1936. No. 470885.

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each. A selection of patents issued in U.S.A. is also included.

The Wireless World

THE PRACTICAL RADIO JOURNAL

27th Year of Publication

No. 957. THURSDAY, DECEMBER 30TH, 1937. VOL. XLI. No. 27.

Proprietors : ILIFFE & SONS LTD.

Editor :
HUGH S. POCOCK.

Editorial,
Advertising and Publishing Offices :
DORSET HOUSE, STAMFORD STREET,
LONDON, S.E.1.

Telephone: Waterloo 3333 (50 lines).
Telegrams: "Ethaworld, Sedist, London."

COVENTRY : Hertford Street.
Telegrams: "Autocar, Coventry." Telephone: 5210 Coventry.

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Telegrams: "Iliffe, Manchester." Telephone: Blackfriars 4412 (4 lines).

GLASGOW : 26B, Renfield Street, C.2.
Telegrams: "Iliffe, Glasgow." Telephone: Central 4857.

PUBLISHED WEEKLY. ENTERED AS SECOND CLASS MATTER AT NEW YORK, N.Y.

Subscription Rates :
Home, £1 1s. 8d. ; Canada, £1 1s. 8d. ; other countries, £1 3s. 10d. per annum.

As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

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EDITORIAL COMMENT

1938

Prospects for the New Year

AS we approach the end of 1937 it is natural that we should look ahead and contemplate what progress in wireless development may be before us in the year to come. The march of wireless has been phenomenal, but it may be said that during the past few years there has been a slowing down in the rate of development of technical improvements in wireless for broadcasting purposes and as a means of general communication. It is as if the inventive efforts of those engaged in research are not being fully utilised either through lack of applications or because circumstances hinder their use.

Not so many years ago progress in wireless communication, for which there were seemingly unlimited applications, was delayed whilst technique was being developed and systems perfected to improve the efficiency or general reliability of the new services.

The ability to reproduce music by broadcasting at a quality almost equal to the original has long since been achieved, but ether congestion and other circumstances prevent us from taking full advantage of this facility. A revision of the distribution of broadcasting and other wavelengths seems to be the next step before further technical improvements can be useful.

To-day we believe that we are correct in suggesting that there are more inventions in wireless and allied subjects than applications have yet been devised to utilise. We find research laboratories carrying on investigations and perfecting electronic devices and other equipment for which, as yet, they have not discovered a use but for which they have faith that uses will eventually be found.

We can take television as an outstanding example. Here we have a complete system for transmitting moving scenes by wire or wireless, and yet the present uses for television are restricted to a dubious interest on the part of the public for entertainment purposes.

When some new application or service to humanity is heralded in these days the scientific inventions necessary to that application are usually to be found waiting, as it were, "on the shelf." The year 1938 requires not so much that we should make rapid progress in scientific invention, but that we should discover worthwhile applications for the waiting list of products of scientific research.

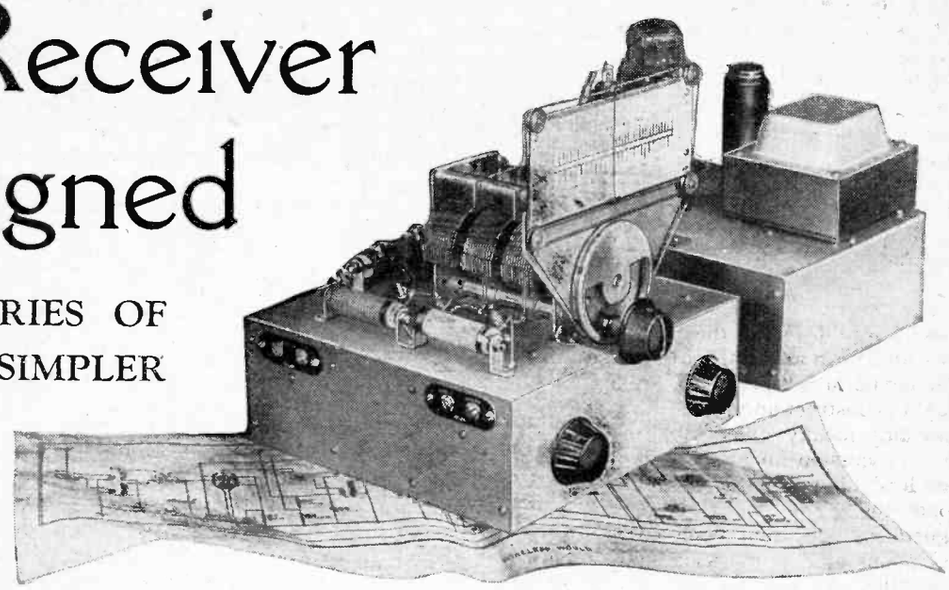
The New Volume

Features for 1938

EACH new year stimulates us in the endeavour to improve *The Wireless World* and add to its usefulness to our readers, and as each year comes round we look forward to being able to add to our readership and widen the influence of the paper. To all those who become new readers with the commencement of the new volume we extend a welcome, and to them and to our present readers our sincerest good wishes for 1938.

Plans have been made which we hope will give satisfaction to all our readers in the matter of the selection of articles and features in forthcoming issues. We do not propose to make any sudden changes but rather to introduce improvements as a gradual process and always with a readiness to attend to special requests from our readers, whose suggestions we await with interest at any time.

How a Receiver is Designed



INTRODUCING A SERIES OF ARTICLES ON THE SIMPLER TYPES OF SET

IDEALLY, the correct procedure in designing a receiver is to decide on the performance required and to work out on paper the type of circuit, number of valves and values of components needed to give that performance. One then constructs the set and tries it out. If nothing has been overlooked in the paper design and no constructional mistakes have been made, it will work in the manner intended. A modern wireless set is so complicated, however, that even the experienced designer often overlooks something, which is revealed in the testing and remedied. It often happens, also, that there are several different ways of obtaining the same performance, and the best design is then the one which uses the least material.

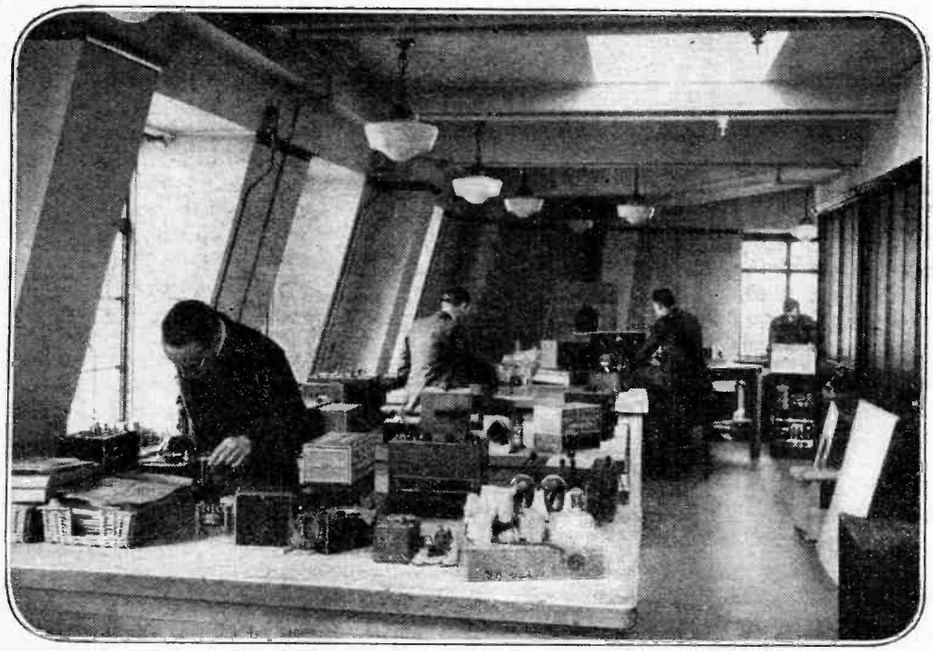
From time to time complete constructional details of receivers designed, constructed and tested in our own laboratory and workshop are published in *The Wireless World*. These receivers are so designed that they can be constructed and adjusted even by those who have little practical experience to guide them, and in cases where any special apparatus is necessary for the initial adjustment this is always indicated in the constructional article. These receivers are intended to illustrate new developments in practical form, or to give a performance or have characteristics which are not obtainable elsewhere. During the last few years, for instance, special attention has been paid to apparatus designed primarily for high-quality reproduction. The long-distance listener and television enthusiast have not been overlooked, however, and much suitable equipment has been described.

Special Performance

Many readers of *The Wireless World* require receivers which are non-standard in the sense that the performance wanted is not obtainable from normal commercially-produced apparatus. This is inevitably so because commercial sets are made to suit average conditions and to give a performance which satisfies the non-technical. Those who have sufficient technical knowledge to realise the improved performance which can be obtained from a specialised design naturally desire this.

It often happens that their needs are met by one of the designs published in *The Wireless World*. There is nothing surprising in this when it is remembered that these sets are often produced in direct response to requests from readers. Even so, there are many who have special individual problems, and their only course is to design their own receiver or to modify some existing design.

To the experienced this is by no means difficult, but those who have not yet gained that experience are less fortunately placed, and they often get into trouble through altering the value of some critical component or involve themselves in unnecessary expense through failing to utilise an existing component of nearly the correct value in some part where the value is not at all critical. In a smoothing circuit, for instance, a designer may specify a four microfarad (4-μF.) condenser rated for 500 volts working. There would not be the slightest objection to the use of an 8-μF. condenser or an even larger capacity in its place. The use of a smaller capacity, however, would probably lead to mains hum. Similarly, with the voltage rating, there is no objection to the use of a condenser rated for 1,000 volts or more, but to use one rated for 250 volts only would be asking for trouble.



A view of *The Wireless World* laboratory in which receiver design is carried on.

Receivers to be Discussed

There are many points of similar nature in receiver design, and in a series of articles starting next week they will be fully treated. These articles will deal with the design of receivers and explain fully how it is done. By way of example simple types of set will be taken at first, and after dealing with the design, constructional details will be given. Nothing

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outstanding in the way of performance is claimed for these sets, but their capabilities will be found well up to the average for their class. They are being described primarily to illustrate in practical form the points discussed in the more theoretical parts of the articles and to reveal clearly the mechanical aspects, such as the layout of components, which have an important bearing on the performance.

The receiver to be first discussed will be of the two-valve type. Such sets are not widely used now, but they still have their uses and form an ideal local-station set of the inexpensive type. They are extremely easy to construct and adjust, and are consequently ideally suited to form the basis for a discussion on receiver design which can lead on gradually to more complex apparatus. The two-valve set will be designed for operation from either DC or AC mains and will consequently include a rectifier in addition to the receiving valves proper.

The later receivers in this series will be of various types and will include "quality" apparatus as well as highly selective long-distance sets. All types of power supply will be catered for, and battery, AC, and AC/DC sets will be dealt with.

Modifying Sets

The treatment adopted in these articles will be that of answering in detail the question, "I want a set with such and such a performance. How can I get it?" The design will be fully discussed and every endeavour will be made to anticipate and reply to the questions which the enquiring mind will continually be putting. Questions such as, "What will happen if I double the capacity of this condenser or that resistance?" "What effect will it make if I use a different valve here?" and so on.

No knowledge of mathematics will be necessary to the understanding of the articles, and even the modification of a receiver for different components or valves will involve nothing but simple arithmetic and in most cases even this can be avoided through the use of tables and abacs.

It is not claimed that at the conclusion of the series the reader will be in a position to sit down in an evening and design a complicated all-wave superheterodyne with automatic volume control, interstation noise suppression, automatic-frequency control, automatic-selectivity control, etc., etc. He will, however, be in a position to appreciate the details of a design because he will understand them, and he will be able confidently to tackle the introduction of modifications to a design so that it more nearly suits his own particular requirements. It may be safe for him to introduce only minor modifications into a complicated set, but he should be able to do a major operation on the smaller and less complex designs.

Of greater importance, by understanding the effect of changes in a design he will in some cases be less eager to carry them out, for he will realise that while they may be beneficial in one respect, they may be detrimental in another. If his circumstances are such that this change suits him, well and good, he can go ahead and carry them out. If it does not suit him, however, he is warned in time.

There is one point in particular which is commonly met with in set design and which causes great difficulty to both amateur and professional alike. It very often happens that there are two or more different ways of achieving the same end and the difficulty is to decide which to adopt. Where the different methods lead to exactly the same performance, of course, a decision is usually easy and one selects the cheapest if one is building a new set, or the most convenient if one is altering an old one.

MANY who understand how a receiver works hesitate to tackle the problems of receiver design, largely because they do not feel sure of themselves. As announced in this article, forthcoming issues of "The Wireless World" will contain a special series written with the aim of helping the amateur set designer.

The real difficulties occur when the performances of the various alternatives are slightly different. From the technical point of view a solution is straightforward. One has only to collect the necessary data on performance for each method, and a comparison will show that one system is perhaps slightly better than another from the point of view of quality, but another gives greater amplification or consumes less power. The selection then depends on the relative importance of the various factors.

The problem gets really complicated, however, when cost must be taken into consideration. This factor must be dealt with by most designers, both amateur and professional. The latter is strictly bound by the necessity for producing a set at a competitive price, and this affects not only the type of circuit adopted and the number and quality of the components employed but the mechanical arrangement of the parts. Complicated layouts increase the cost through the need for special tools and through the greater amount of time needed for assembly.

These last considerations do not affect the amateur designer, and in the mechanical arrangement he has only to keep within his ability as a mechanic. The problem of cost of components usually remains, however, and often affects his design through his desire to make use of existing parts. He may, for instance, have on hand a mains transformer which is rated for a somewhat smaller output than his proposed receiver calls for. He has then to decide whether to obtain a new transformer or to redesign his receiver to consume less power. The latter course is the cheaper, but he will have to sacrifice performance in some way, usually in undistorted output.

In order to make a decision he must have a good idea of the performance obtainable in the two cases and he must then balance the difference in performance against the difference in cost and come to his own decision. No one can help him there, but it is obviously impossible to decide unless he can obtain a reasonably good idea of the relative performance of his alternatives, and to enable him to obtain this is one of the main purposes underlying the series of articles we are discussing.

To take a concrete example of the sort of thing that often happens, let us suppose that a certain receiver has an output stage which requires about 280 volts and gives an output of 2½ watts. The mains transformer must have an output of, say, 300 volts, but the designer finds that he has one by him giving 275 volts. This means that his output stage may have 260 volts only and his problem is to decide whether or not this will be satisfactory. An exact calculation of the output under the new conditions is not difficult but is tedious, and a rough indication will probably be sufficient to enable him to decide.

A corner of *The Wireless World* workshop where experimental receivers are constructed.

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For small changes in anode voltage the power output is roughly proportional to the square of the anode voltage, and the two figures for anode voltage in the above case would be about 250 volts and 235 volts. The lower voltage will thus give him about 1/1.13 times the power, or 2.2 watts as compared with 2.5 watts. A change of this order is likely to be inaudible and he will consequently be safe in using his transformer.

There are very many places where component values are not at all critical, and if it were not for this few of us would be able to make a set without a fully equipped laboratory. One can nearly always find an optimum value for a component and a designer naturally chooses it. In many cases a large departure from it will affect the performance negligibly.

While this is true of many components, there are plenty of others where the value really is critical and quite a small change will have a very serious effect. Before one can safely change circuit values it is necessary to know the precise effect the change will have, and it is just this knowledge the reader of the articles starting next week will gain.

Hints and Tips

Practical Aids to Better Reception

Automatic Bias in Battery Sets

THERE is a tendency at present towards the use of automatic biasing circuits in battery receivers, and they will be found in quite a number of the latest models. By adopting this arrangement, all the grid biasing is carried out automatically within the set by means of resistances, leaving no confusing leads marked GB-1, 2, and so on, for the purchaser to worry about. This is, of course, a great advantage, but it would seem advisable to warn readers that care must be taken not to allow any short-circuit of the HT to occur, even momentarily, in auto-bias sets. Such a short-circuit is liable to "burn out," or rather "blow up" the large-capacity electrolytic condenser invariably connected across the bias resistance in a most decisive manner—usually with a loud report, accompanied by a most unpleasant smell and complete demolition of the condenser!

The reason for this alarming behaviour is that this type of electrolytic condenser is not intended to withstand a working voltage greater than 25 or 50 volts maximum, whereas during a severe short-circuit the current passing through the bias resistance may easily develop across it a voltage several times greater. Fortunately, a momentary "short" does not always produce such devastating results, and one may very often be lucky enough to escape disaster; nevertheless, it is just as well to be warned in good time and so take all reasonable care.

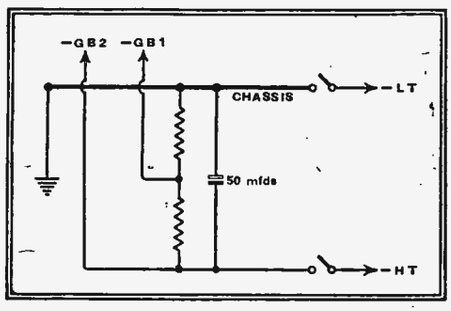


Fig. 1.—Typical arrangement for obtaining automatic bias in a battery set.

Testing Diode Circuits

WHEN confronted with a typical IF circuit followed by the usual diode detector it is as well to remember that the latter requires a moderately large signal to operate it. It may happen when looking for a fault that a modulated oscillator signal, if applied to the immediately preceding IF transformer, fails to come through because its amplitude is insufficient to actuate the diode. One might in such circumstances waste time looking for a breakdown in a section of the set that quite possibly is in good order. Usually it will pay to go one stage further back, i.e., to the last IF valve, and make sure by checking the voltage on screen and anode and across the bias resistor that the valve is working correctly. A case is in mind where the IF valve was not getting its screen current—a very common cause of trouble—although owing to the first-mentioned fact a superficial test had suggested that there was a failure in the chain *after* this stage.

Where a test becomes desirable it may be mentioned that a DC voltage applied across the secondary of the last IF transformer should cause a click to be heard in the loud speaker if the circuit is in order from there onwards. A standard pocket-lamp battery is very convenient for this operation; it should be applied with polarity each way in turn.

Adding a Valve

IN the event of one wishing, for experimental or any other reasons, to add an extra valve to a factory-built steel chassis, the difficulty always is where and how to mount the necessary valve-holder. Very few people possess either the inclination or suitable tools to cut a hole of $1\frac{5}{16}$in. diameter in a stout steel chassis, as would be necessary to permit the fitting of a standard chassis-mounting valve-holder in orthodox fashion. It is suggested, however, that the problem can be circumvented by mounting the valve-holder on "legs," or distance-pieces, above the chassis (see Fig. 2), and merely drilling a single hole of reasonable size to accommodate the incidental wiring. Any standard type chassis- or even baseboard-mounting valve-holder can be used, and convenient distance supports are readily obtainable from any dealer in S.W. components. It is advisable to use flexible wire for the connections, so that the valve-holder can be held in a vertical plane while the wires are being attached and afterwards returned to the horizontal for fixing in position.

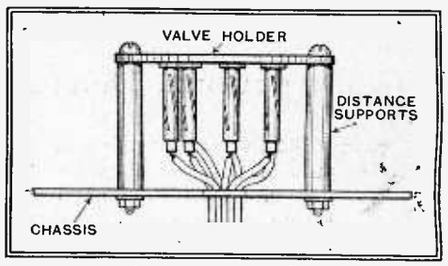


Fig. 2.—An easy way of mounting a valve-holder on a steel chassis.

Retrimming IFs

AS a general rule it is not a wise plan to attempt to readjust the IF trimmers of any receiver without having access to a suitable oscillator for the purpose. Apart from the difficulty of finding a signal which is sufficiently steady to render any sort of comparison possible, there is also the danger that in making adjustments one is liable to wander farther and farther away from the correct intermediate frequency.

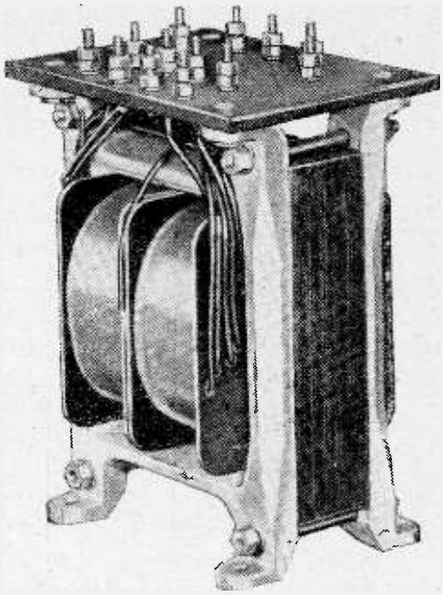
Where the set includes one or more SW bands, however, it is possible to make an exception to this rule. With any superhet having a single-peaked IF amplifier, the sensitivity on short waves must depend very largely on the accuracy of the IF alignment; so much so that a very small amount of "wandering" by one of the IF trimmers can be responsible for quite a serious drop in short-wave signal strength. Fortunately, it is found in practice that the IF amplifier can usually be lined up easily and accurately on a suitable short-wave signal. The tuning is so sharp that it is hardly possible to go wrong, and here again one is fortunate in that it is invariably possible to find some high-speed morse transmission which will be found an excellent substitute for a constant note. One which emits a continuous signal and does not fade excessively should be selected and tuned in accurately with the tuning control. The IF trimmers are now adjusted very carefully one by one until the signal is at its loudest.

Readers are also reminded that there are now on the market quite inexpensive devices of the buzzer or neon type which emit a steady note of the exact frequency required for carrying out tests on any commercial IF amplifier.

Universal Output Transformer

Constructional Details of a Multi-ratio Component

By H. B. DENT



REQUESTS for constructional details of this transformer, which was described in *The Wireless World* of December 1st, 1933, still continue to be received, and as the issue in question is now no longer available, it is felt that the essential data, in abridged form, for its construction may be of interest. Experience has shown that this transformer will satisfy almost every condition asked of it, and no good purpose would thus be served by preparing a new design.

Possibly its response could be improved slightly at frequencies above 10,000 c/s by greater sectionalisation but its construction would then be so complicated that difficulty might be experienced in following the written description. It is also doubtful if it could be made with the workshop facilities of the average home constructor. As designed it has virtually a flat response from 30 c/s to about 7,000 c/s, and it is only about 5 db below the average level on any ratio at 10,000 c/s.

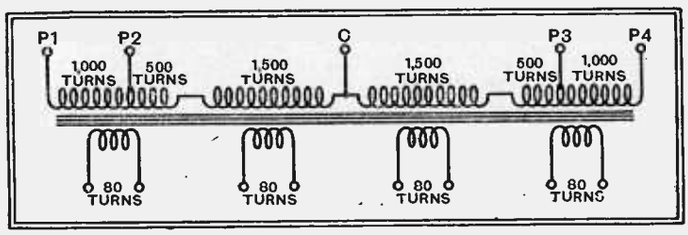


Fig. 1.—Theoretical arrangement of the transformer showing the symmetrical disposition of the windings.

It can still be regarded as a perfectly satisfactory universal output transformer for all normal requirements.

The design allows for use either as a push-pull transformer or with a single-ended output stage, as it will carry 60 mA or so of DC and still provide an adequate primary inductance. Six watts of audio power were originally given as its output capabilities, but in a push-pull circuit this figure can be safely doubled without overloading the transformer.

Its windings are arranged as shown theoretically in Fig. 1, four primary and four secondary sections being employed. The windings are carried on two bobbins each $1\frac{5}{16}$in. wide and of a suitable size to take a core $1\frac{1}{4}$in. thick made up of Stalloy No. 33 stampings. Both are wound in exactly the same manner, and each has two primary and two secondary sections.

In the final assembly one bobbin is turned round so that its direction of winding is opposed to that of its companion. It is, therefore, most important that the various sections be inter-connected and joined to the terminal plate in the correct manner. The actual arrangement of the windings and the manner in which they are connected are shown diagrammatically in Fig. 2. The inners and outers of each are marked, and in order to avoid confusion insulating sleeving of different colours should be threaded on the various lead-out wires when the bobbins are being wound.

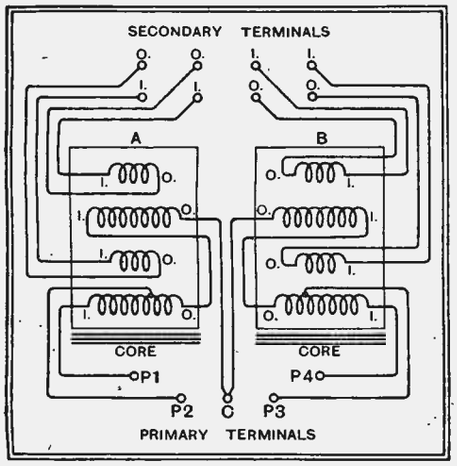


Fig. 2.—The relative position of the windings, inter-coil connections and wiring to terminal board is clearly shown by this schematic layout.

Before starting to wind the bobbins the end cheeks of each are drilled in accordance with the particulars in Fig. 3. The upper one is of the outside cheek while the lower relates to the inside one, and this applies to both bobbins. The holes should be larger than absolutely necessary to pass the wires, and it is suggested they be at least $\frac{1}{8}$in. in diameter so as to allow for any slight difference in winding depth of the sections.

The winding procedure is as follows:—First, 1,000 turns of No. 32 SWG enamelled wire is wound on evenly and a tapping is brought out, then 500 turns more put on to complete this section. Two layers of good quality empire cloth or heavy waxed paper are needed for insulation, then follows 80 turns of No. 20 SWG enamelled wire. Over this is wound two layers of insulating material, then 1,500 turns of the No. 32 wire. Again insulation is applied, and finally 80 turns of the No. 20 wire. The other bobbin is wound in a like manner

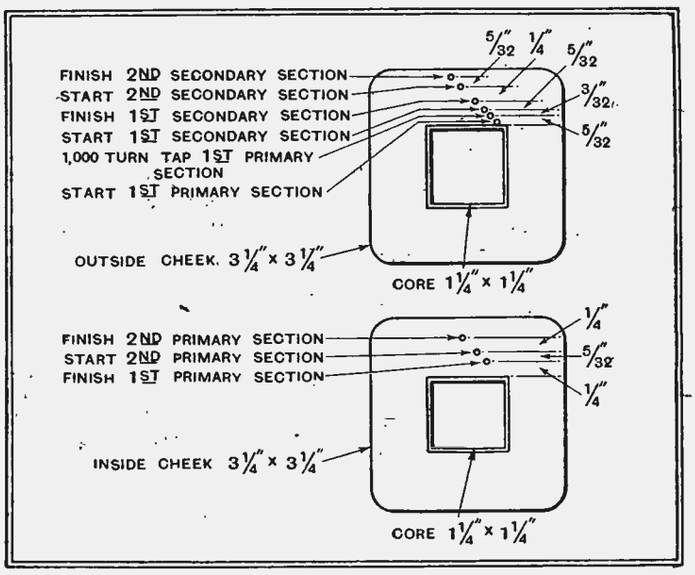


Fig. 3.—In addition to giving the position of the holes in the bobbins this drawing serves as a winding identification chart.

The thin wire with which the primary is wound should not be brought out through the end cheeks, as it may be damaged or become broken during the winding process and subsequent assembly

Universal Output Transformer—

of bobbins and stampings. Any likelihood of this happening can be avoided by soldering to the beginning and end of each section a foot of heavier gauge wire, or, better still, thin flex such as 9/36's.

Use a non-corrosive flux for this purpose and also take the additional precaution to thoroughly clean the joint with pure methylated spirit.

It only remains now to assemble the core. The two bobbins are placed side by side as in Fig. 2, so that *all* secondary leads on bobbins A and B are on the outside of each bobbin. The only free wires on the adjacent inside cheeks are the pair, one from each bobbin, that join to the centre terminal of the five that form the primary connections.

For the core about 90 pairs of Stalloy No. 33 stampings are required, and they are assembled with all like-shape pieces on one side. As the transformer is intended to carry some 60 mA of DC an air-gap must be inserted in the core, its size for this transformer being 0.01in. This is just three times the thickness of the paper on which *The Wireless World* is printed. This transformer provides eleven different ratios from 75 to 1 to 12.5 to 1, and of these, seven can be used for push-pull working. Actually there are twelve possible combinations, but two provide the same ratio. These ratios are given in the accompanying table.

TABLE OF RATIOS AND CONNECTIONS

Ratio.	Primary Connections.	Secondary Connections.	Secondary Resistance.
*12.5 : 1	P2 and P3	Four sections in series ...	1.76 ohms
15.6 : 1	P1 and P3	Four sections in series ...	1.76 ohms
*16.6 : 1	P2 and P3	Three sections in series ...	1.32 ohms
*18.7 : 1	P1 and P4	Four sections in series ...	1.76 ohms
20.8 : 1	P1 and P3	Three sections in series ...	1.32 ohms
*25 : 1	(1) P1 and P4	(1) Three sections in series	1.32 ohms
	(2) P2 and P3	(2) Two sections series / Two sections parallel	0.44 ohms
31.2 : 1	P1 and P3	Two sections series / Two sections parallel	0.44 ohms
*37.5 : 1	P1 and P4	Two sections series / Two sections parallel	0.44 ohms
*50 : 1	P2 and P3	Four sections in parallel ...	0.11 ohms
62.5 : 1	P1 and P3	Four sections in parallel ...	0.11 ohms
*75 : 1	P1 and P4	Four sections in parallel ...	0.11 ohms

* These ratios can be used for push-pull.

The interconnections of the terminals for four chosen ratios are shown in Fig. 4, from which also the layout of the top terminal board can be seen. The drilling of this can well be left to the constructor, as the illustration of the finished transformer shows clearly the arrangement of the terminals—¾in. 4BA screws and nuts—and the manner in which the ebonite or Paxolin plate is secured.

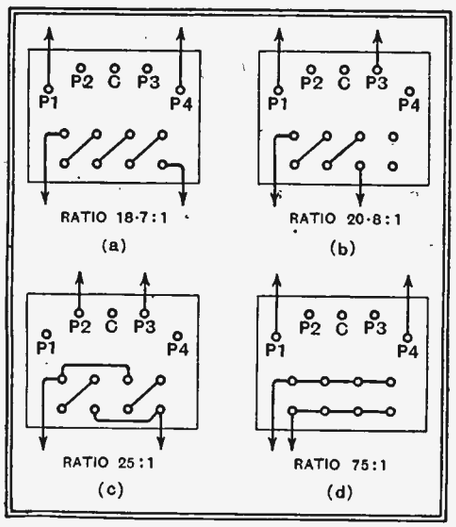


Fig. 4.—The secondary terminals joined as in (a) place all four sections in series ; (b) gives three sections connected in series ; (c) two in series and two in parallel, while (d) shows the four sections in parallel.

Material Required.

90 Pairs of Stalloy No. 33 stampings Jas. Sankey & Sons, Sound Sales
2 Bobbins Sound Sales
3¼in. × 3¼in. × 1 5/16in. with 1¼in. × 1¼in. hole.
1 Pair aluminium end-clamps Sound Sales
1½lb. No. 32 S.W.G. enamelled wire ; 1lb. No. 20 S.W.G. enamelled wire ; quantity empire cloth ; quantity insulated sleeving, various colours.
13 4BA ¾in. brass screws, round head, with like number of soldering tags and washers.
4 4BA ½in. countersunk screws ; 30 4BA nuts.

Dictionary of Radio Terminology in the English, German, French and Russian Languages, by A. S. Litvinenko, edited by Prof. V. I. Bashenoff, Mem.I.R.E.; Moscow, U.S.S.R., 1937. In one volume of 559+xlii pp. Obtainable from Collet's Foreign Department, 31, Gerrard Street, London, W.1. Price 17s.

THERE is, to our knowledge, at least one quite good English-German dictionary devoted to the terms of wireless engineering, and at least one German-English volume to correspond. There very likely may be a similar pair for English-French and French-English, and even, possibly, an English-Russian and Russian-English pair. Each of these six volumes would presumably cost about what used to be called, in the days of gold coinage, "half a thick 'un," and their dates of compilation might easily range from, perhaps, 1925 onwards, so that many of them, at least, would lack quite a number of important terms, particularly those concerned with television.

The present single volume provides the facilities, not only of these six more or less hypothetical volumes, but also of six others—twelve two-language dictionaries in all—with the added advantages of being uniformly up-to-date and of giving the rendering of any word in one language simultaneously in the other three. This last property is extremely useful when, as often happens, a precise shade of meaning can be cleared up by such inter-comparison. The work has been carried out admirably, and the volume is as easily handled by an English reader as by a Russian, German or French one. Even the prefaces (one of which is very interesting in its exposition of the ambiguities and anomalies of wireless terminology) are printed in the four languages. The ingenious system of compilation which enables some 25,000 English, German, French and Russian terms to be arranged alphabetically in one continuous volume, without causing any complication or confusion, is due, we are told, to the Russian expert Lengnik; it is extremely effective.

H. D.

BLUE PRINTS OF WIRING DIAGRAMS

Full-size blue prints of the following receivers and amplifiers described in recent volumes of *The Wireless World* are still available from the Publishers, Dorset House, Stamford Street, London, S.E.1. Price 1/6, post free.

Four-Band Super-Six.
AC Superheterodyne covering 10.5 to 2,000 metres.
December 9th and 16th, 1937.

30-Watt PA Amplifier.
AC Equipment for Public Address with Mixer and Tone Control stages as a separate unit.
September 10th and 17th, 1937.

Straight Six.
High quality AC receiver unit for use with PP Amplifier.
August 20th and 27th, 1937.

AC Short-wave Converter.
Three-range unit covering 12.5 to 62.5 metres.
April 9th and 16th, 1937.

Recording Amplifier.
Dual-purpose AC Quality unit with an undistorted output of 4 to 6 watts.
March 19th, 1937.

Negative Feed-back Amplifier.
High-quality Push-pull output unit for AC/DC Operation.
November 13th, 1936.

Pre-tuned Quality Receiver.
Local Station AC Set with Switch Tuning.
September 25th and October 2nd, 1936.

All-Wave Super Seven.
Sensitive Three-Band AC Set with Variable Selectivity.
August 7th and 14th, 1936.

Holiday Portable.
Self-contained Four-valve Battery Set.
June 5th, 1936.

Variable Selectivity IV (Battery Model).
Four-Valve Superheterodyne with AVC.
May 8th and 15th, 1936.

12-watt PA Amplifier.
High-Fidelity AC Equipment with separate Feeder Unit.
April 3rd and 10th, 1936.

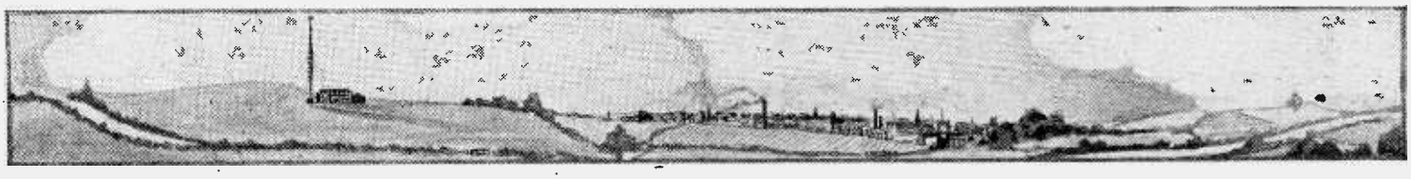
QA Super.
Six-valve Receiver Unit Design for Use with the PP Quality Amplifier.
February 28th and March 6th, 1936.

"By Request" Crystal Receiver.
A "Stand-by" Set Designed on Modern Lines.
February 7th, 1936.

Universal Gramophone Amplifier.
Two-stage AC/DC Unit employing Pentodes in Parallel.
January 24th, 1936.

Imperial Short-wave Six.
Four-range AC Superhet covering 6 to 100 metres.
January 3rd and 10th, 1936.

Push-Pull Quality Amplifier (AC).
Resistance-coupled Distortionless Output Unit.
Special reprints of constuctional notes available. Price 6d. Postage 1½d.



Signal Strengths—DURING DAYLIGHT AND DARKNESS

Measured Variations on Medium and Long Waves

By "CATHODE RAY"

HOW strong is a signal? Two years ago A. L. M. Sowerby showed very clearly with a graph the relationships between different classes of signal—"local," "strong distant," "average distant," etc.—their strengths in microvolts, the types of set capable of receiving them, and the amount of "noise" likely to interfere with them. The word "noise" is understood to refer to unwanted radiation set up by certain types of electrical appliances other than transmitting stations.

For the benefit of those who are unable to turn up this article—it is dated December 13th, 1935—I repeat Sowerby's sensitivity estimates for the classes of sets that remain in common use (Fig. 1), as I consider that they still hold good. The numbers of microvolts (μV) specified are those needed to give standard output (50 milliwatts) under certain conventional conditions. The signal strength to give *full* output is, of course, greater, but not so much greater as might be supposed, for the milliwatts are proportional to the *square* of the number of microvolts, and sensitivity is measured at only 30 per cent. modulation. A hundred per cent. modulation at the same strength should give $50 \times \left(\frac{100}{30}\right)^2 = 555$ milliwatts, and doubling the signal microvolts increases this to 2,220 milliwatts, which is more than most so-called $3\frac{1}{2}$-watt sets can yield in real comfort. I will also repeat the limits of the different classes of signal strength:

Local stations ..	7,000-1,000,000 μV
Strong distant stations	700-10,000 μV
Average distant stations	25-1,200 μV
Weak distant stations	1-35 μV

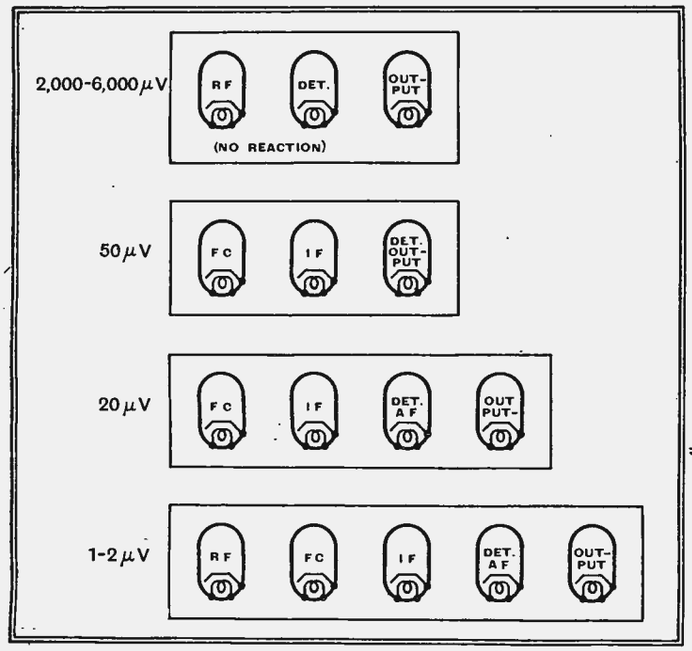


Fig. 1.—Typical sensitivities of receivers of different classes, according to Sowerby. There is a big gap between the only "straight" set, at the top, and the three superhets; but this is partly filled in by reaction, controllable or otherwise. With extreme reaction it is sometimes possible to reach superhet sensitivity.

It is to be understood that these are the microvoltages picked up by a reasonably good outdoor aerial. Reception from any one station, if subject to fading, is liable to shift from one to another of the above classes.

My object just now is to go into greater detail with regard to this part of the information by passing on some results of measurements on actual stations coming into all of the above classes. In explaining How to Avoid Remote Control (July 31st, 1936), I did give figures for the three available stations in the "local" class—the two Londons and Droitwich. The results that follow were obtained in the same way, but on another aerial in the same district. Although the latter aerial is on higher ground and has a longer vertical portion, the total length is less, and this seems to have an overruling influence, for the microvoltages measured in the new location are one-third less for the Londons and a half for Droitwich. Many outdoor domestic aerials would certainly be much worse still, and a few would be better. Average indoor aerials might pick up only a twentieth of the signals tabulated here, and as shown in my previous article, "Mains Aerial" reception may be less than a hundredth.

For the purpose of getting the following results it was essential to avoid any reception due to possibly very much stronger signals on adjacent channels, so a 5-valve superhet was used with the variable-selectivity control turned round to maximum. Fig. 2 shows diagrammatically the system used. The diode detector circuit was opened and a microammeter interposed to read rectified current. The full range of available signal strength came between 1 and 6 microamps. When a station had been accurately tuned in and the deflection noted, the aerial terminal of the receiver was switched over to a standard signal generator, which was then adjusted to give the same microammeter reading; and the signal strength given by the generator was assumed to be the same as the original picked up by the aerial. The only

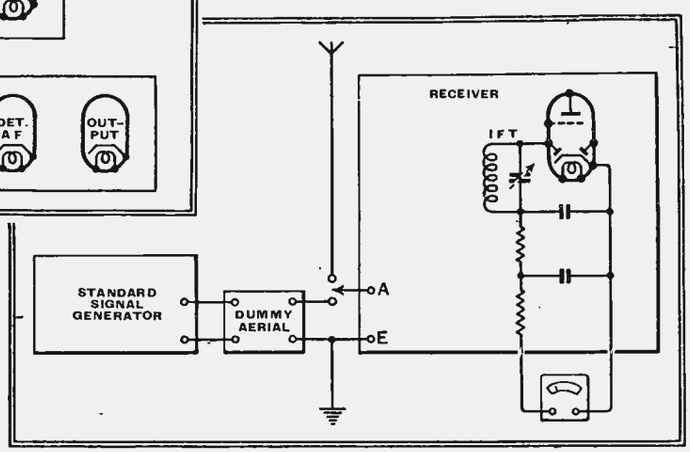


Fig. 2.—How the results were obtained. The receiver is switched over from the outdoor aerial to a dummy aerial and standard signal generator.

Signal Strengths—

flaw in this assumption is that the generator reading necessarily has to be obtained with the real aerial replaced by a standard dummy aerial, which although very similar in electrical characteristics, cannot be absolutely identical over the whole frequency band covered. If very high-frequency signals had been included, the error due to this false assumption might have been rather serious; but as nothing more was being expected than an approximate idea of things under typical conditions there did not seem to be much ground for worrying about a minor difference between conditions of reception and measurement.

The figures for night reception, and the remarks about fading, are subject to very large variations from day to day and even during a single day. They are typical of results obtained during several days at the beginning of November of this year. I hope to pursue the fading aspect of the subject a little farther on another occasion; at present the figures should be looked at chiefly as indications of the sort of signal strengths likely to be obtained. Readers in other districts should be able to re-shuffle the names of the stations so as to make the distances and frequencies of some of them correspond approximately to their own situations. For instance, a listener at Donaghadee, in Northern Ireland, could interchange the names of Stagshaw and West Regional, and of London Regional and Northern Ireland Regional.

Conditions of Test

The situation where these observations were made could be described as fairly quiet electrically, being in a not very crowded suburban district. Reception is described as intelligible when the words can be distinguished and, if in English, understood; but not necessarily so well received as to be easy or pleasant to listen to. References to quality of programme have nothing to do with the form of entertainment being broadcast; a "good programme" is one that is not noticeably marred by background noise or fading. Owing to the high selectivity the tone quality was not very good in any case, and with the selectivity broadened out to maximum response very few stations indeed could be received without any interference.

All the B.B.C. stations are included, because information about them is most likely to be reliable, and a few of the more interesting foreigners. All stations sharing a channel are shown, except those so distant or low-powered as to be safely considered relatively negligible.

Now for some conclusions. With the exception, very slightly, of Midland Regional (which almost certainly would have been no exception at all if it had been observed long enough during darkness), any difference in strength between day and night is an increase at night. But the change is not invariably one for the better. When there is a very pronounced increase after dark, fading is liable to be correspondingly pronounced. Liable to be; but within the short limits of time available for observing each station—generally several periods of about 3-5 minutes—fading was not always as bad as it might be expected to be on occasions. The signal strengths given are generally about the maxima, leaving out of account brief upward swings.

Night fading has been well-known for years, but I was rather surprised to find that some of the distant stations faded far more badly in daylight than at night. Daylight fading, when present, generally consisted in the strength fluctuating widely and irregularly all over the place, whereas at night the same stations faded downwards from some more or less definite high level. A curious thing—it may be just a coincidence—is that the stations other than the locals, although showing widely different microvoltages by day, come up to a fairly consistent level in the region 1,500-4,000 μV at night.

The results demonstrate the familiar experience that the higher the frequency of a station the shorter the distance at which it is liable to fading. Thus Hilversum at over 200 miles is quite steady, whereas

DAY AND NIGHT SIGNAL STRENGTHS AS MEASURED NEAR LONDON

Station.	Rated Power kW.	Distance Miles.	Frequency kc/s.	Wavelength Metres.	Signal Strength μV.	Remarks.
Hilversum I ...	10 / 150	210	160	1,875	D 1,900 / D 7,500	Before and after change of power.
Radio-Romania ...	150	1,250			N 7,300	Some sideband interference and slight fading, apparently due to shared channel.
Moscow	500	1,560	172	1,744	D 135	Intelligible programme, but some background.
					N 1,000	Mainly due to jamming!
Droitwich ...	150	105	200	1,500	DN 27,000	Perfectly steady.
Kalundborg ...	60	580	240	1,250	D 1,000 / N 2,500	See text.
Budapest	120	900	546	549.5	D 130	Slight fading; a poor programme, subject to spark interference.
					N 4,300	Fairly steady. A good programme.
North Regional...	70	170	668	449.1	D 1,300	Steady. Negligible background.
Jerusalem... ...	20	2,300			N 3,000	Some fading, down to about 300 μV.
Rome	50	900	713	420.8	D 300 / N 3,800	Some fading, but a good programme.
Scottish Regional	70	350	767	391.1	D 200	Fading down to zero.
Burghead	60	450			N 2,000	A good programme. No distortion.
Welsh Regional...	70	150	804	373.1	D 680	Steady. Fairly good programme; very slight background.
Penmon	5	215			N 1,600	Slight fading.
London Regional.	70	24	877	342.1	DN 67,000	
N. Ireland Reg....	100	325	977	307.1	D 100	Severe fading. Fair at best, but noisy.
					N 1,500	Slight fading. Good programme.
Hilversum II ...	15 / 60	210	995	301.5	D 400 / D 750	Before and after change of of power.
					N 4,000	Some fading. Good programme.
Midland Regional	70	105	1,013	296.2	D 1,100	Steady. Very slight background.
					N 1,000	Severe fading.
West Regional ...	50	150	1,050	285.7	D 320	Steady. Fair programme, but considerable background.
					N 460	Considerable fading.
Stagshaw	60	260	1,122	267.4	D 55	Violent and continuous fading. Intelligible at best.
Nyiregyhaza ...	6.25	1,000			N 3,000	Some fading. Good programme.
London National..	20	24	1,149	261.1	D 26	(Scottish only.) Violent and continuous fading. Just intelligible at best.
North National ...	20	170				
Scottish National	50	350			N 21,000	Slight 1½ sec. swing due to imperfect synchronisation.
Aberdeen	1	410	1,285	233.5	D 5	Modulation drowned by background.
Dresden	0.25	580			N 85	Severe fading. Bad to fair programme.
Bournemouth ...	1	90	1,474	203.5	D 19	Occasional intelligibility, but very noisy.
Plymouth	0.3	190			N 47	Bad fading and swinging. Fairly intelligible, but a poor programme.

D = Daylight over the whole distance between transmitter and receiver.

N = Night; i.e., darkness over the whole distance between transmitter and receiver.

Signal Strengths—

Midland Regional at half that distance fades badly. As it happens, Midland Regional is at that awkward combination of distance and frequency at which the ground wave and reflected wave are of comparable strength, so that one is liable alternately to cancel out and reinforce the other. At greater distances the reflected wave predominates and is less likely to fade right out. The same sort of fading is likely to occur when two stations of comparable strength are working on the same frequency; and if the stations are synchronised there may be distortion too.

I am in some doubt about Kalundborg.

	Signal Strength Ratio.	Signal Strength Ratio Squared.	Power Ratio.
Hilversum I	$\frac{7500}{1900} = 3.95$	$3.95^2 = 15.6$	15
Hilversum II	$\frac{750}{400} = 1.88$	$1.88^2 = 3.5$	4

Its distance and frequency do not rule out the possibility of an appreciable increase due to darkness, but the large increase observed, in conjunction with freedom from fading, makes me suspect a power increase. There definitely is a power increase in the two Hilversums, and the observed strengths confirm the advertised changes; see accompanying table.

In the two London transmitters at equal distance we have an opportunity to study the influence of frequency alone. If the power of the National were raised to that of the Regional the signal strength ought to rise to $21{,}000 \times \sqrt{\frac{70}{20}} = 39{,}000$. This is 40 per cent. lower than that of the Regional, presumably due mainly to the increased absorption over the intervening ground (almost wholly urban) at the higher frequency. The same can be done with Midland Regional and Droitwich, having a much greater frequency difference; but none of the other pairs is entirely free from shared channel complications. However, West Regional and Welsh Regional can be compared if the probably small influence of Penmon is neglected. In every case, after due allowance has been made for difference in power, the lower frequency station yields the stronger signal. This is fortunate, because noise and atmospherics are generally stronger, too.

Empire Transmissions

CALL SIGNS AND FREQUENCIES

All times shown are G.M.T.

		Mc/s	Metres
TRANSMISSION 1. 8.15 a.m.–10.25 a.m.			
GSG	Australia and India	17.79	16.86
GSO	Australia and New Zealand ...	15.18	19.76
GSF	Australia and New Zealand ...	15.14	19.82
GSD	Australia and New Zealand ...	11.75	25.53
GSB	Australia and New Zealand ...	9.51	31.55
TRANSMISSION 2. 10.45 a.m.–1.55 p.m.			
GSJ	Malaya, India, Australia and West Indies	21.53	13.93
GSH	Africa	21.47	13.97
GSG	Malaya, India, and Australia...	17.79	16.86
GSO	Far East and New Zealand ...	15.18	19.76
GSF	India, Malaya, and Australia...	15.14	19.82
TRANSMISSION 3. 2.15 p.m.–5 p.m.			
GSH	Africa	21.47	13.97
GSG	India, Malaya, and Australia...	17.79	16.86
GSF	India, Malaya, and Australia...	15.14	19.82
GSD	India, Malaya, and Australia...	11.75	25.53
TRANSMISSION 4A. 5.20–8.45 p.m.			
GSG	Africa generally	17.79	16.86
GSP	North America (from 6.45 p.m.)	15.31	19.60
GSD	Africa generally	11.75	25.53
GSB	Near East and East Africa ...	9.51	31.55
GSA	Near East and East Africa ...	6.05	49.59
TRANSMISSION 4B. 9.0–11.0 p.m.			
GSO	South America...	15.18	19.76
GSD	West Indies and Central America	11.75	25.53
GSC	North America...	9.58	31.32
GSB	Africa	9.51	31.55
TRANSMISSION 5. 11.20 p.m.–1.30 a.m.			
GSC	North America...	9.58	31.32
GSB	South America...	9.51	31.55
GSB	West Indies, Central America, India, and Malaya	9.51	31.55
GSL	North America and East Africa	6.11	49.1
TRANSMISSION 6. 2 a.m.–4 a.m.			
GSD	Western Canada	11.75	25.53
GSC	Western Canada	9.58	31.32
GSB	West Indies, Central America, and India	9.51	31.55
GSL	North America and East Africa	6.11	49.1

Choosing the Frequency.

TRANSMISSION 1

Listeners in Australia should tune to GSD with GSG, GSO, and GSF as standbys. Listeners in New Zealand should tune to GSB or GSO. GSO should also be audible in the Far East and GSG in India and Malaya.

TRANSMISSION 2

GSH is directional to Africa and GSO to the Far East. Listeners in India, Malaya, and Australia should tune to the other three frequencies, GSJ, GSG, and GSF.

TRANSMISSION 3

GSH is again directional to Africa in this transmission and the other frequencies, GSG, GSF, and GSD are intended for reception in India and Malaya.

TRANSMISSION 4A

Listeners in South and West Africa should tune to GSG or GSD, and listeners in East Africa to GSB or one of the other frequencies. From 6.45 p.m. listeners in Canada should tune to GSP, and in the Near East to GSA or GSB.

N.B.—It is probable in South Africa that GSG, will give the best reception at the start of the transmission, GSD becoming the best frequency from 6.0 p.m. The same will be approximately true of West Africa.

TRANSMISSION 4B

GSB is for the whole of Africa, one of the GSC transmitters for Canada and North America, the other GSD transmitter for the West Indies and Western South America, and GSO for South America, that is Brazil, Argentine, Uruguay, etc.

TRANSMISSION 5

GSC and GSL are for Canada and North America, GSB for West Indies and Western South America and the East, and the second GSB for South America, etc., as above, and the Far East.

TRANSMISSION 6

GSC and GSD are for Western Canada, the GSB transmitter is for West Indies and Western South America and the East, and the other GSL transmitter for Eastern Canada and East Africa.

Ceramics

USES IN MODERN RADIO COMPONENTS

CERAMIC is a general term covering a wide variety of materials, of which pottery in its many forms is possibly the most common. Porcelain also falls in this category and in quite recent times a new development has been the production of special non-hygroscopic insulators and insulating material for use in high-frequency radio work.

These special materials possess not only low-loss characteristics at high radio frequencies, but, most important of all, they can be made to show a high order of stability under widely varying conditions of temperature and humidity.

Some of the many applications of these materials in the field of radio were shown at a recent exhibition held by the United Insulator Co., Ltd. Condensers, inductances, valves, and various other wireless components now make use of ceramic as an insulator, while some of the special forms are employed as dielectrics in variable and fixed condensers.

The principal ceramics supplied by the aforementioned firm are known as Calit, Calan, Ultra Calan, Conda N, Conda C, Tempa S and Tempa N respectively. Each of these materials has different properties and some are best suited for insulators, while others, possessing very high dielectric constants, find application as dielectrics in condensers.

The more recent developments have been the depositing of metal on the ceramic, and as some of the materials, particularly Conda N and Conda C, can be moulded into various shapes with thin walls, condensers of very high capacity and showing exceptionally good stability can be made up in compact form.

The metal can be applied now in sufficient thickness to enable connections or other metal parts to be actually soldered on to it.

Good Test Results

A few examples will suffice to indicate the high dielectric constants now obtainable with these new ceramics.

That for Calit, which finds many applications as an insulator, is 6.5, but Conda C has a dielectric constant of 80, and consequently is generally used as a dielectric in condensers. As a comparison the average dielectric constant of mica is 7.

A new application is now being found for ceramic in the construction of inductances where high stability and low loss at the high radio frequencies are required.

A moulded former is made with a spiral groove on the outside and in this groove is deposited a layer of metal, copper generally being employed. Inductances thus formed are actually in use in some of the latest short-wave transmitters.

In the construction of very small condensers such as of a few m-mfds. only, unusual shapes such as discs and hats, or cups as they are sometimes called, are adopted, while for larger capacities ceramic tubes coated inside and outside with metal are used. One of the advantages of the ceramic condenser is that it can be made with tolerances as small as 0.5 per cent., while it has also a very high order of stability.

Listeners' Guide for the Week

Outstanding Broadcasts at Home and Abroad

RETROSPECTION on New Year's Eve is inevitable, and it has not been excluded from the broadcast programmes. From 10.45 (Nat.) we shall have in the programme, "Nineteen Hundred and Thirty-Seven," an hour's broadcast review of the year, produced by H. L. Morrow. Following this, until midnight, the Rev. Iremonger, B.B.C. Director of Religion, will conduct a special service in the Concert Hall.

At midnight Big Ben, the most popular individual broadcaster in the Empire programmes, will herald 1938. As soon as the last stroke of the hour has died away, listeners will be taken on a radio tour of Great Britain and given an impression of how she is entering upon a new year.

The Watchnight Service at St. Paul's Cathedral will open this broadcast, after which three short messages from Northern Ireland, Scotland, and Wales, describing the celebrations in each place, will be heard. Howard Marshall will then, from a studio, picture for listeners scenes in various parts of the country. The final call will be to the Chelsea Arts Ball at the Royal Albert Hall, where Tommy Woodrooffe will describe the colourful scene until the stations close down at 12.20 a.m. Earlier in the evening, at 5.30 (Nat.), he will be in a London street inviting passers-by to say a few words on their resolutions for 1938.

A PAGEANT OF HISTORY

THIS title would well describe the Empire programme, "The Guildhall," which National listeners will hear on Tuesday at 12.15. It is unfortunate that a broadcast on so famous a building should be given at such an obscure hour, but it is an Empire programme we are sharing.

The story is based on episodes in the history of this famous City building. Gog and Magog, the two giant wooden effigies which stand in the Common Hall, will, in this programme, figure as continuity compères. They will tell how in 1411 a meeting place was erected, on the site of an earlier building, for trade guilds, and that it was after the Great Fire in 1666, which razed the Guildhall to the ground, that the present edifice was built.

The history of the Guildhall is full of drama, and the radio story will not leave this untouched.

NEW VARIETY FEATURE

AN experimental run of about six weeks will be given to the new weekly variety show, "The Band Wagon," which will be introduced to Regional listeners on Wednesday at 7.55. It will be produced by Gordon Crier, who, in joining the Variety Department as a producer, is the first person to leave television for sound broadcasting.

The feature will be based on a dance band with which will be guest artistes. A problem by Hans W. Priwin, the creator of Inspector Hornleigh of "Monday at Seven," will be incorporated each week, the solution of which will be given during the next programme. There are many artistes who have passed the B.B.C. audition but have never had the opportunity of broadcasting. Three such people will be included each week in this attractive new feature.

CRIMINAL PLAY

"MY LIFE WITH ERNEST RULE" is the title of a new play for broadcasting by Horton Giddy. This play, which will be heard at 8 (Reg.) on Saturday, combines adventure with domesticity, centring round a situation, at once, melodramatic and drab. Ernest Rule is a criminal in the same unenviable position as the perpetrator of that abominable series of murders known as "The Brides in the Bath." Irony is lent to the situation by the fact that his final intended victim defends him in the witness-box with all the loving indignation at her poor command.

CIRCUS RELAYS

THE Outside Broadcast Department are arranging for relays from two of London's circuses, at Olympia and Islington. From 7.30 (Reg.) on Wednesday listeners will hear for twenty minutes descriptions of items from these two circuses accompanied by the clamour associated with the sawdust ring. The broadcast will open at Bertram Mills' circus at Olympia where John Snagge will be commentator and will alternate with Thomas Woodrooffe at Pleasure-fair's production at the Agricultural Hall.

LESLIE HOWARD, the famous actor and film star, is here seen rehearsing for his recent first broadcast in England, in "Berkeley Square." He will take the title rôle in "Hamlet," a part which he has played on the boards in the States, when it is broadcast Nationally on Sunday at 9.5, as the fourth play in the series "World Theatre."

TO BE CONTINUED

WE are now to have a serialised broadcasting version of Alexandre Dumas' famous romantic melodrama, "The Count of Monte Cristo," to be completed in twelve consecutive Monday broadcasts, commencing on January 3rd at 8.30 (Nat.).

The adaptation has been carried out by Patrick Riddell, who will be remembered for his excellent treatment of "Twenty Years After" and "The Three Musketeers," etc. The story

HIGHLIGHTS OF THE WEEK

THURSDAY, DECEMBER 30th.

Nat., 7.50, B.B.C. Orchestra (D), conducted by Albert Coates. 9.20, The Sinking of H.M.S. *Audacious.*

Reg., 8.30, A grand Christmas concert from Madron, Cornwall. 9.15, "Cinderella": a new setting of an old story.

Abroad.

Strasbourg, 8.15, Rossini's "The Barber of Seville," from the Theatre, Metz.

FRIDAY, DECEMBER 31st.

Nat., 5.50, A broadcast by passers-by in a London street. 8, The Kentucky Minstrels. 10.45, "1937": a broadcast revue of the year. 12.1, The New Year: sound shots of the entry of 1938.

Reg., 8, The microphone at large: a visit to Stow-on-the-Wold. 9.20, Variety from the Palace Theatre, Blackpool.

Abroad.

Strasbourg, 8.30, Humperdinck's fairy opera "Hänsel and Gretel."

SATURDAY, JANUARY 1st.

Nat., 3.10, Rugby commentary from St. Helen's Ground, Swansea. 7, Songs of the Spanish Provinces. 8, Music Hall.

Reg., 3.30, The Kentucky Minstrels. 8, "My life with Ernest Rule": a new radio play.

Abroad.

Hilversum No. 2, 9.20, Mozart's "Bastien et Bastienne."

SUNDAY, JANUARY 2nd.

Nat., 6.30, "The Cato Street Conspiracy." 9.5, Lydia Lopokova in "Imperial Ballet."

Reg., 6.30, Sunday Orchestral Concert. 9.5, Leslie Howard in "Hamlet."

Abroad.

Leipzig, 7.10, Gala operetta concert.

MONDAY, JANUARY 3rd.

Nat., 8, Recital: Olive Groves (soprano). 8.30, Serial: "The Count of Monte Cristo."

Reg., 8, Dance Band relay from America. 9.20, History of comic songs: 1—In the good old days.

Abroad.

Frankfurt, 8.15, Pfitzner concert, the composer at the piano.

TUESDAY, JANUARY 4th.

Nat., 7.45, Broadcast version of "The Geisha." 9.35, The British Women's Symphony Orchestra.

Reg., 8.30, Discussion on disappearing Georgian London. 9, Jack Payne's Party.

Abroad.

Eiffel Tower, 8.30, Grand Symphony Concert.

WEDNESDAY, JANUARY 5th.

Nat., 7.45, B.B.C. Orchestra (D) and Cyril Smith (piano). 9.20, A. J. Alan.

Reg., 1.15, Round the London organs: St. Paul's Cathedral. 7.30, Relays from circuses. 7.55, "The Band Wagon."

Abroad.

Strasbourg, 8.30, Mozart-Bruckner concert. Soloist: Szigeti (violin).

concerns the fortunes of Edmond Dantes, a young sailor, who is wrongfully imprisoned on his wedding day in the Château D'If, his dramatic escape, and vengeance on the men responsible for his suffering.

A. J. ALAN AGAIN

THE mystery man of British broadcasting, whose identity has always been kept a close secret, will again be heard by National listeners on Wednesday at 9.20. He will be telling a new story, "A Talk in the Train," details of which are as veiled as the story-teller's identity.

OPERA AND OPERETTA

THE performance of Schmalstich's new operetta "Wenn die Zarin lächet" from Radio-Munich on Friday at 6.15 is described as a wonderful New Year's Eve surprise. This operetta, when produced for the first time at the Opera House, Berlin, just recently, was an enormous success. Schmalstich is a true pupil of Humperdinck, and is the composer of much light and pleasing pianoforte music. He is director of the Berlin Opera House.

The opera which Mozart composed and produced at the age of 12, "Bastien et Bastienne," comes from Hilversum No. 2 at 9.20 on Saturday. Milan gives us something newer on the same evening at 8, a three-act opera by Licinio Refice, a priest-composer, who normally confines himself strictly to sacred themes although the present work, "Margherita da Cortona," does not appear to be a sacred subject. Refice is a teacher at the Pontifical School of Sacred Music.

One does not look for full-dress opera from Radio-Luxembourg, but Tuesday brings at 9 a performance of the "Magic Flute" with some of the best opera singers of France and Belgium in the cast.

THE AUDITOR.

Broadcast Brevities

NEWS FROM PORTLAND PLACE

Technical Hitch Makes History

NO precedent exists for the extraordinary train of technical hitches which prevented the relaying of the Eddie Cantor programme from Hollywood on Monday of last week.

The show was being broadcast over the Columbia network and relayed by the C.B.S. short-wave station at New Jersey. Tatsfield made an attempt to pick this up, but conditions were too bad, so resort was had to the ever-helpful Post Office and its beam system.

The beam was not helpful, for a very un-Cantorlike talk was picked up, and it then transpired that the C.B.S. short-wave station was "lost." Which was not surprising, considering that that station had inadvertently started up on the wrong frequency!

Why Not a Tuning Note?

The lesson to be learnt from this harrowing story is surely that short-wave stations should send out a tuning note for at least fifteen minutes before beginning a programme. This would enable frequencies to be checked in advance.

New 100-kW Station

IT was stated in these columns nearly a year ago that the B.B.C. would ultimately construct two new transmitting stations, one of high and one of medium power, to radiate the Regional programme to the south coast and south-west of England. The high-power station, Start Point, Broadcasting House now announces, will operate on 100 kW, the wavelength being 285.7 metres. Two 500 ft. masts will be constructed, one to be used as the aerial and the other as a reflector to reduce the strength of radiation over the sea to the south, and to give a corresponding increase in other directions.

The Service Area

Start Point will be ready early in 1939, and is anticipated by the B.B.C. engineers to serve an area which includes coastal districts from the south-west of Cornwall to Sussex, as well as Dorset and the southern parts of Cornwall, Devonshire, Hampshire and Wiltshire.

The medium-power station, which will radiate the same programme and will come into use at the same time as Start Point, will be situated near Clevedon, in Somerset. It will serve areas around Bristol and the northern and western parts of Somerset which cannot be covered effectively by Start Point.

End of Plymouth and Bournemouth

Clevedon will use a wavelength of 203.5 metres at present shared by Plymouth and Bournemouth. These two transmitters will be closed down when Start Point gets into its stride, as the new "big brother" will serve adequately the areas which they at present cover.

Theoretical Conflagration

REGRETFULLY it must be recorded that several prominent members of the B.B.C. staff were theoretically burned to death a few days ago during a practice "fire" at Broadcasting House. Little consolation is afforded by the fact that other equally prominent people were saved twice.

The bells rang out when the majority of the staff were busily occupied in rehearsals and broadcasts, yet the Floor Fire Directors had been so efficiently drilled that the "death-roll" was encouragingly low.

A Bell Problem

One of the unique difficulties in Portland Place is concerned with the type of fire bell used. The bells must be loud enough to reach all offices and studios without undue interruption of a transmission. Moreover, practice ringing must be arranged in such a way that studio activities are interfered with as little as possible.

Such requirements would give any self-respecting fireman a sick headache.

You May Hear It

Following the theoretical fire, it has been decided that bigger and better bells must be used, and that they must be tested occasionally, irrespective of any other considerations, so listeners who remain glued to their sets may one day be rewarded by hearing the fire alarm breaking in on a broadcast.

Air Raid Precautions

All of which is a reminder that the B.B.C. is similarly prepared for air raids, and one day some theoretical bomb dropping may be practised over Portland Place.

Confidential instructions to station directors and engineers all over the country provide for a strict routine if enemy aircraft are reported.

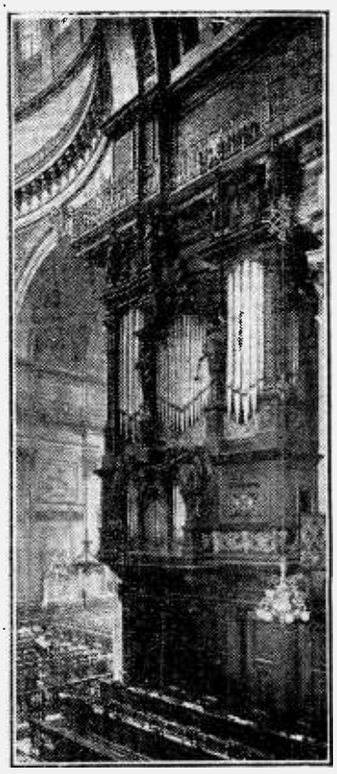
It is understood that certain key stations would continue transmitting, while being in readiness to close down at a moment's notice in order to prevent hostile 'planes from using their carriers for DF purposes. Droitwich, being well away from Continental air routes, would probably give an emergency "National" service. Lisnagarvey, with its 100-kW output, could also cover the country in a crisis.

Who Will be the Superman?

THE B.B.C. will shortly be seeking a superman to direct the destinies of the world propaganda service, which will outstrip in importance any of the work at present conducted by the Foreign Department at Broadcasting House.

Working in more or less close touch with the Foreign Office, this official will wield pontifical power, and the feeling is growing in Portland Place that the responsibilities will warrant the establishment of a fifth Controllership. The official's title would probably be Controller of International Intelligence, and the post worth something like £3,000 per annum.

In the meantime, the organisation of the new Foreign News Department is in the hands of Sir Stephen Tallents, Controller of Public Relations.



ST. PAUL'S CATHEDRAL organ, which will be described and a recital given on it by John Dykes Bower, the Cathedral organist, in the first of the series of programmes, "Round the London Organs." This will be heard Regionally at 1.15 on Wednesday.

The Year's Progress

DEVELOPMENTS IN NON-BROADCAST WIRELESS COMMUNICATIONS

FOLLOWING our usual practice, we publish in this, the last issue of the old year, a comprehensive survey of recent developments in wireless communication throughout the world. The past year has been notable for extensions in the use of wireless by small vessels and also for the provision of increased navigational and service facilities for civil aircraft.

By LT.-COL. CHETWODE CRAWLEY, O.B.E.

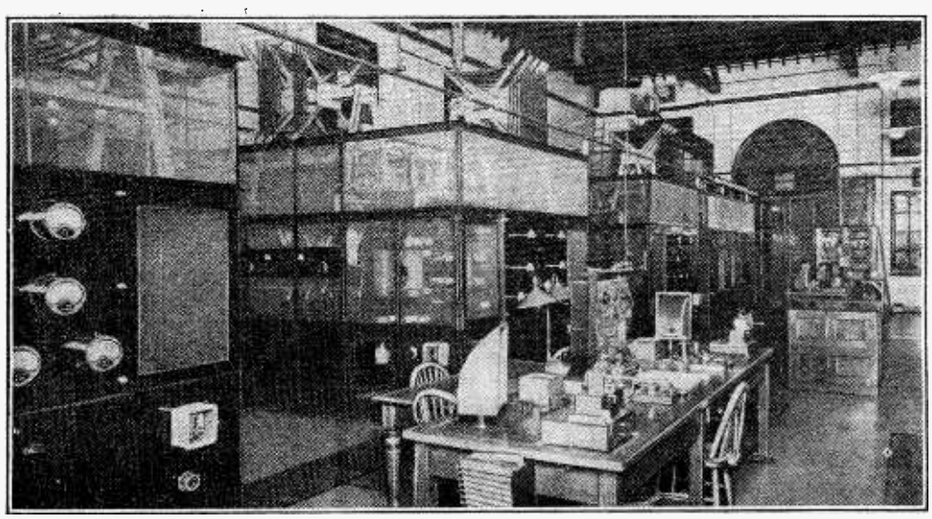
MARCHESE MARCONI, the originator of wireless communication, died on July 28th this year. His death was felt as a personal loss by thousands of wireless workers all over the world, as he was not only the first to show how electric waves could be used for wireless communication, but he had remained for forty years the dominating personality in its development.

He was a great inventor, but it was his courage and enthusiasm that held him as the leader throughout his life. Those who knew him mourn the loss of a loyal friend and a modest, courteous gentleman.

On the telephone side this year there has been more progress in the extension of circuits than in the opening of new ones, and there has been, too, a welcome reduction in the rates for many services. In January, reduced rates for calls on Saturday were introduced in the services to Chile, Uruguay, Paraguay, Palestine and Syria, and a new circuit was opened between Rome and Addis Ababa. In February, the service to Beyrouth in Syria was extended to Damascus without an increase in charge, and the service with the Dutch East Indies was extended to a number of places in Southern Sumatra, with charges, from this country, of a little over £5 for three minutes' conversation. In March, a service was opened between Japan and Siam at a charge of £2 2s. for three minutes, and in April, Moscow was connected to Yakutsk, Archangel, Rudolf Island and other Arctic stations. In April, too, the longest direct circuit in the world was opened, Tokio-Buenos Aires, 11,500 miles, at a charge of £9 for three minutes.

On April 14th, on the occasion of the opening of new premises at Overseas House by the Duke of Gloucester, a London audience was addressed by the Viceroy of India and the Governors-General of all the Dominions. This was a significant and epoch-making example of the possibilities of radiotelephony for promoting the unity of the Empire.

On the occasion of the Coronation, charges on the main Empire routes were reduced for the month of May from £4 10s. to £3, and corresponding reductions were made for extensions. In June, the rate to India was reduced from £4 10s. to £3, and to Japan from £6 to £4 16s. The hours of service for South Africa were considerably extended, and the Saturday reduced rate of £3 was extended to each weekday after 2 p.m. In June, too, a service was opened between the U.S.A. and China. In July, reductions were made in the rates to the more distant zones in the U.S.A. and Canada, and in the night and Sunday rates to Cuba. The rate to Iceland was reduced from £1 10s. to £1 4s., and an extension of the England-U.S.A. circuit was made to Jamaica at a charge of £6 3s. This extension is by land line from New York to Miami, and thence by wireless. The Anglo-Egyptian circuit was extended to Bagdad in September at a charge of £4 7s., or on Saturdays £3 3s., and the Argentine service was extended to Paraguay. In November, the rates for Egypt, Palestine, Syria and Iraq were reduced by 12s. In December, a service was opened between this country and Malaya, via Java and the Holland-Java radio circuit, at a charge of £5 5s., and the charge to Java itself was reduced to £4.



More than half the British radio-telegraphic traffic with ships now passes through Portishead Radio, which has four short-wave transmitters.

Ultra-short-wave Links

During the year a number of islands off the Scottish coasts were connected to the mainland by ultra-short-wave telephone circuits, and in August nine new short-wave circuits were added to the six existing ones between Portpatrick in Scotland and Ballygomartin, near Belfast. Details of these circuits were given in *The Wireless World* of September 10th.

Hundreds of broadcasts involving the use of radiotelephone circuits took place as usual. Notable amongst these were the broadcasts on Coronation Day, the ceremony of unveiling the French Memorial at Montfaucon to the U.S.A. soldiers who died in the war, and the opening from Lossiemouth of the Canadian National Exhibition by the Secretary of State for the Dominions.

Mention of broadcasting calls to mind the rapid progress of television, though it is really outside the scope of this article, not yet having entered the commercial field. The first public event to be televised in a regular programme was the boxing tournament of the Alexandra Amateur Boxing Club on February 4th, the first outside broadcast was that of the Coronation procession taken at Hyde Park Corner, the camera being connected to Alexandra Palace by nine miles of special cable, and the first visual message to be televised to a ship at sea was sent on October 29th from Alexandra Palace to the Cunard-White Star motor-ship *Britannic* in the English Channel.

At the beginning of the year Cable and Wireless, Ltd., opened a phototelegraph service between London and Buenos Aires, and in April a similar though temporary service between London and Japan.

The Year's Progress—

In February, telegraph services were opened between New York and Monrovia and between Lima, in Peru, and Santiago, in Chile. In April, services were opened between Cayenne and Paris and between Moscow and Prague; in June, between Brussels and Oslo; in July, between Macao and Portuguese India; in August, between British Honduras and Mexico City and between Lima and Buenos Aires; in September, between Tokio and Santiago; and in October, between Rome and Copenhagen.

A Siemens wireless telephone installation for small vessels.

Calls for Help

Our ship-shore communications started the year with an unfortunate record, as in January there were 41 distress and other casualty cases dealt with by our coast stations, a record number for one month. These 41 cases occupied 224 hours of signalling time, compared with 24 hours for 12 cases in January, 1935. There are, of course, far more ships fitted with wireless than was the case a few years ago, largely due to the introduction of simple telephone sets in small craft, such as fishing vessels and coasters. The number fitted has continued to increase during the year, and there are now some thousand British small craft fitted with these installations. At coast stations, operator-watch is kept on the telephone wave detailed for these vessels (149.1 metres) at scheduled periods throughout the day and night, and, in addition a loud-speaker watch on the international radiotelephone calling wave of 181.8 metres was introduced at the stations in July. This loud-speaker watch is in operation whenever the stations are not in actual communication with ships, and besides facilitating the communications of our own small craft, it is available for the small foreign ships fitted with this international telephone wave. Arrangements have been made, too, during the year for lighthouses and lifeboats round our coasts to make use of this wave for distress communications with the coast stations.

Wick Radio, at the North of Scotland, is the most important station for communication with small craft, and as it carries over half the small ship total traffic, in addition to other ship communications, it was found necessary to increase its capacity for traffic. Arrangements were accordingly made, and completed this year, to allow of two channels being worked simultaneously. This was done by connecting an aerial system, about a mile from the station, by coaxial cable to a screened operating room in the station, a more economical arrangement than using separated transmitting and operating stations.

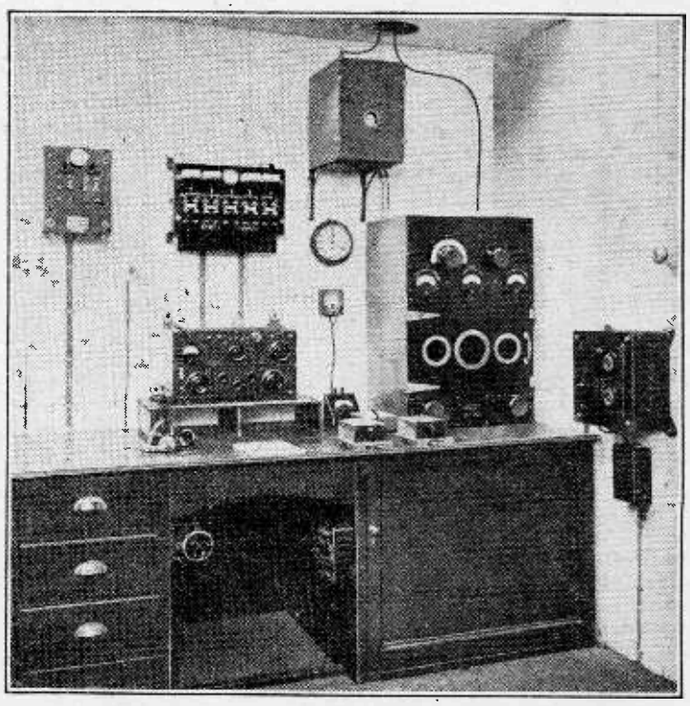
For some time past the stations at Seaforth, near Liverpool, and at the Humber have been able to connect telephone calls to and from ships with subscribers on shore by means of the landline telephone network, but at the other stations the ships can only communicate by radiotelephony with the stations and vice versa, the messages being telegraphed between the stations and the senders or addressees on shore. This through telephone link service from Seaforth and Humber was put on a permanent basis for subscribers in Great Britain and Northern Ireland in September, and extended to the Irish Free State in November, at a charge of 7s. for three minutes' conversation. The reliable range of telephone communication for these small craft is about 100 miles from the coast station, but far greater ranges are often obtained.

All these arrangements for telephone working between small craft and the shore form an important advance in the use of wireless for the safety of life at sea, though there is still no legal necessity for any ship under 1,600 tons to be fitted with a wireless installation. Larger ships which can afford to carry an operator are fitted with telegraphy, and the law requires that all over 1,600 tons must be so fitted. The better state of shipping this year has been reflected in an increase in the number of ships fitted with telegraphy, of which about 3,800 are British. Of these British ships, about 145 are fitted with medium-wave CW, and 350 with short-wave ICW.

Portishead Radio is the coast station which deals with ships of these two classes, and more than half the total traffic with ships passes through this station. The transmitters are at Portishead, and consist of three medium-wave, four short-wave, and a low-power telephone transmitter for small craft. The operating station is 30 miles away at Burnham, where a staff of over 40 operators is employed. Four services are conducted from this station—a medium-wave telegraph service for ships within a distance of about 2,000 miles (four receivers available), a medium-wave telegraph service for ships within a distance of about 300 miles (two receivers available), an intermediate-wave telegraph and telephone service for small craft (two receivers available), and a short-wave service for ships in any part of the world (11 receivers available).

More Aircraft Facilities

As might be expected, there has been considerable development during the year in the wireless communications of civil aircraft. These communications are connected with the service and navigation of the aircraft and are rapidly increasing in volume in a much greater proportion indeed than the increase in the number of aircraft. This is due to the addition of facilities for navigation by wireless, such as more numerous landing beacons, all-round beacons and DF apparatus. These developments at ground stations necessitate increased complexity in the aircraft installations, so that in the larger aircraft it is now becoming common practice to have an ordinary communication



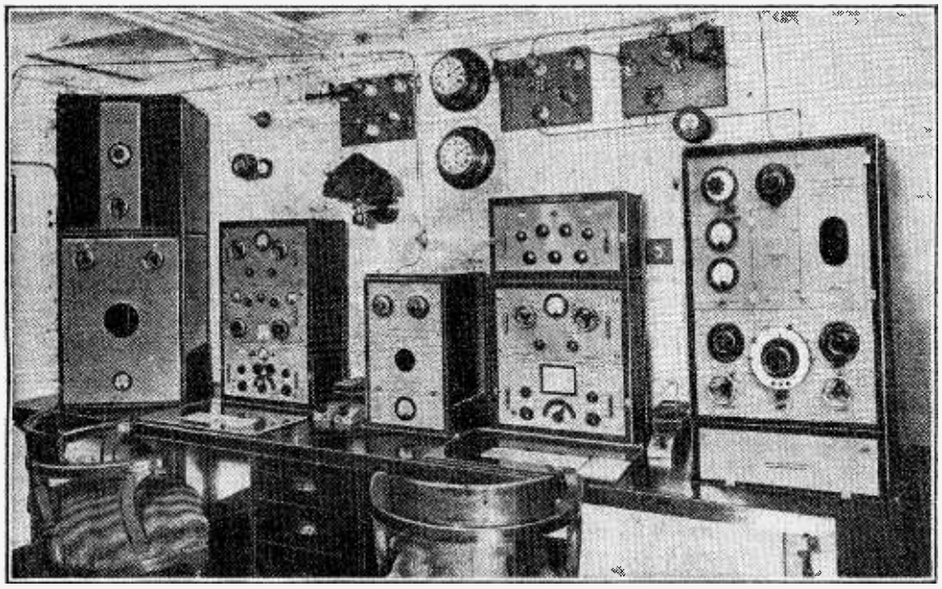
Marconi ½-kW. telegraph installation for coastal and similar ships.

The Year's Progress—

set, a DF loop with separate receiver, and a receiver for very short wavelengths.

Telephony is now little used on the international routes, but still predominates on the inland routes. Striking progress has been made in the use of directional apparatus employing ultra-short waves at close range, and short waves at long range, and some experimental work has been carried out with the application of the cathode-ray tube for DF purposes. A number of internal ground stations fitted for communication and DF have been added during the year, the Pulham and Lympne stations have been largely re-equipped, and additional DF and landing facilities have been installed at Croydon. Many teleprinter landline connections between aerodromes have been added, and some short-wave wireless circuits installed where landlines are uneconomic. Several new stations have been completed on the Empire routes, the total number of these stations being now well over a hundred.

A new station in the Irish Free State at the Shannon Base was brought into operation early in the year in readiness for the transatlantic test flights which commenced in July. The marked success of these flights was due, in no small measure, to the information provided by a scheme of wireless communications based on close co-operation between the aircraft, the wireless stations at the Air bases, ships at sea, and Post Office land stations.



Gambrell ½-kW. ship's set, including short-wave and emergency transmitters.

The use of wireless for police purposes has increased considerably during the year. In October, the station for Scotland Yard was transferred from Scotland House, adjoining the Yard, to a new station at West Wickham for transmission, and Denmark Hill for reception, operation being conducted from Scotland Yard. A description of the station was given in *The Wireless World* of October 29th.

Many extensions for police working were made also in the provinces, and a network of channels for this purpose is rapidly spreading over the country for communications where landlines cannot be used.

Distant Reception Notes

The Russian Problem

ONE can't help wondering how much longer the nations of Europe in general, and the U.I.R. in particular, are going to tolerate the selfish and inconsiderate attitude of the Russian broadcasting authority, which refused to play when the Lucerne plan was formulated and generally accepted.

There can't be much doubt that the present chaotic condition of the long wave-band is due to no small extent to the Russian stations. On this band alone there are nine of these stations with output ratings between 20 kW and 500 kW, and eight out of the nine are causing serious interference with other transmitters.

Moscow No. 1, a 500-kW station, works on 1,744 metres with a separation of only 6 kilocycles from Lahti; Irkutsk (20 kW.) is but 3.5 kilocycles away from Deutschlandsender; Minsk (35 kW) uses the same wavelength as Reykjavik; Novosibirsk (100 kW) is 1.5 kilocycles removed from Motala; Moscow No. 2 (100 kW) is on the same wavelength as Luxembourg—though one can't feel very much sympathy for one of the pioneer "pirate" stations; Moscow No. 2 is also but 8 kilocycles from Kalundborg on the one side, while Kiev No. 1 is 8 kilocycles away on the other. Tashkent (25 kW) operates within 3.6 kilocycles of Oslo and Tiflis (35 kW) is within one kilocycle of Tromsö.

The only unoffending Russian long-wave station is the 100-kW Leningrad No. 1, which is separated by 11 kilocycles from its neighbours on either side.

On the intermediate band there are six Russian stations rated at from 10 to 100 kW. Here Archangel works within 3 kilocycles of Finmark, Rostov-on-Don within 4.5 of Budapest No. 2 and Voronezh within 2 of Boden and Banska-Bystrica.

Of the dozen medium-wave stations with ratings mostly about the 10-kW mark—Moscow No. 3 is 100 kW and Kiev No. 2 is 35 kW—Kharkov interferes at times with Hilversum (Lopikerkapel), Stalino can be a nuisance when Toulouse PTT is required, Simferopol does not improve Strasbourg . . . and so on and so on.

The Russian stations that I have mentioned are those in the more westerly parts of the country alone. Wireless, unfortunately, knows no geographical boundaries, and there are others not appearing in the usual lists which cause interference with European stations that abide scrupulously by the Lucerne Plan.

Surely Russia, now one of the great centres of wireless development, might adopt a more unselfish attitude. If she came into line with other countries at the next international conference both she and they would benefit.

D. EXER.

Television Programmes

TELEVISION PROGRAMMES.

An hour's special film transmission intended for the Industry only will be given from 11 a.m. to 12 daily.

Vision 45 Mc/s. Sound 41.5 Mc/s.

THURSDAY, DECEMBER 30th.

3, "Ski-Heil!": programme of winter sports. **3.20,** Gaumont-British News. **3.30,** Bridge played by members of the Edinburgh Horatians **3.40,** Cartoon film. **3.45,** "Plus ca change."

9, "Ski-Heil!" **9.20,** British Movietonews. **9.30,** Starlight. **9.40,** Cartoon film. **9.45,** From Æsop's Fables.

FRIDAY, DECEMBER 31st.

3, Lady Gregory's "The Workhouse Ward." **3.25,** British Movietonews. **3.35,** Music-Hall Party.

9-10, "From Alexandra Palace: 1936–1937": reminiscences of the outstanding television events since the first transmission from A.P. in August, 1936.

SATURDAY, JANUARY 1st.

3, Puppet Conjuring. **3.5,** Gardening: how to keep indoor plants. **3.20,** Gaumont-British News. **3.30,** Television's first grand Christmas pantomime "Dick Whittington and his Cat."

9, "Coffee Stall": a light entertainment. **9.20,** British Movietonews. **9.30,** Lisa Minghetti (violin). **9.40,** Cartoon film. **9.45,** "The Tragic Muse": a diversion by James Bridie.

MONDAY, JANUARY 3rd.

3, Starlight—Phyllis Robins. **3.10,** The Potter's Wheel: a demonstration by Joan Cowper. **3.25,** Gaumont-British News. **3.35,** The Vic-Wells Ballet Company.

9, Cabaret with Flotsam and Jetsam; Ernest Sewell, conjuror; The Karsovas, Russian dancers; and Inga Anderson, songs. **9.25,** British Movietonews. **9.35,** The Vic-Wells Ballet Company.

TUESDAY, JANUARY 4th.

3, O.B. from Bertram Mills' Circus at Olympia. **3.30,** British Movietonews. **3.40,** Variety.

9, Ingrid Linck, songs, and Catherine Marks, dances. **9.15,** Gaumont-British News. **9.25,** Play: "The Tin Soldiers." **9.50,** The Aspidistras.

WEDNESDAY, JANUARY 5th.

3, A little show. **3.20,** O.B. from Olympia Circus. **3.30,** 109th edition of Picture Page.

9, A little show. **9.20,** O.B. from Olympia Circus. **9.30,** 110th edition of Picture Page.

Readers' Problems

A selection of queries dealt with by the Information Bureau, and chosen for their more general interest, is published on this page.

Stability versus Amplication

AN observant querist has noticed that the well-established practice of earthing the heaters of AC valves via a centre-tapping on the LT secondary of the power transformer is nowadays often abandoned in favour of a direct connection to one side of the heaters. He asks which is the best arrangement to adopt for a receiver in which hum is to be reduced to a minimum.

It has been found that the direct earthing of the valve heaters makes it easier to obtain complete stability in RF or IF amplifiers, while at the same time the practice does not provoke hum unless exceptionally high audio-frequency amplification is used. Therefore, if the overall AF gain of our correspondent's set is to be high, he should use the centre-tapped method.

Dissecting an American Set

A CORRESPONDENT who has been searching for a fault in an American set designed several years ago is puzzled by the arrangement of the RF coupling transformer. This is parallel-fed from a choke in the preceding anode circuit, and there seems to be only one connection to the primary coil.

We expect that the RF stage includes a form of mixed capacity and inductive coupling of the kind shown in Fig. 1 (*a*), in which transference to the secondary is made both by virtue of the inductance of the coil L and its capacity in relation to the secondary L1. So far as the capacity coupling is concerned, the arrangement is comparable with Fig. 1 (*b*), except that the RF choke Ch is probably arranged to resonate somewhere near the low-frequency end of the broadcast waveband. Arrangements of this kind are devised to give constant coupling over the waveband covered.

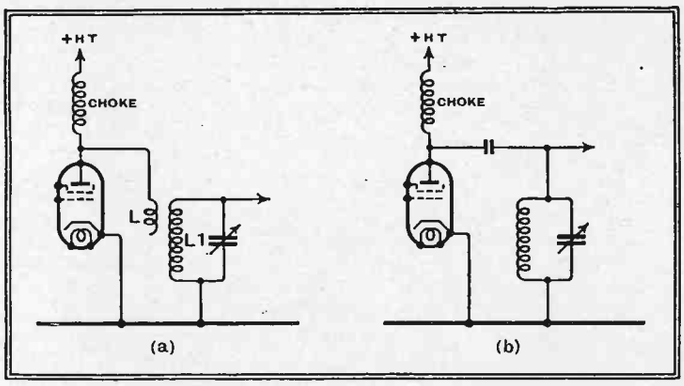


Fig. 1.—In so far as the coupling is partly capacitative, the American RF transformer shown at (a) is comparable with the familiar "tuned grid" coupling (b).

Large-Primary Transformers

AS an aid to accurate circuit alignment in radio-frequency amplifiers, the type of transformer having a primary with a much greater number of turns than formerly employed is coming into increasing use. A correspondent who has successfully wound his own coils for this system of coupling has found that the relative direction of winding of primary and secondary has some slight effect on the effectiveness of the arrangement, and asks whether this is normal.

If primary-to-secondary coupling is purely magnetic, relative direction of winding should be immaterial, but where a small auxiliary coupling capacity is introduced (see *The Wireless World* of November 4th) this matter is of importance. It will also come into the picture when the primary coil is mounted in proximity to the high-potential (or grid-connected) end of the secondary, as a certain amount of stray capacity coupling will be taking place in this case.

Better Aerials

URGED by the eloquence of those who have recently stated the case for "bigger and better" aerials in the pages of this journal, a correspondent sends for criticism a sketch of his present arrangement, and asks whether it would be worth while to raise the end of the aerial remote from the house by a height of some 15 feet.

Our querist sends an admirably clear sketch to illustrate his proposed alteration, and we think that this is one of those comparatively rare cases where we can guarantee that his efforts will be rewarded by a noticeable improvement in signal-to-noise ratio—which is all that really matters when one is using a highly sensitive modern set. By raising the aerial 15ft. its spacing from a wing of the house running under it will be increased by that amount, with an almost certain improvement with regard to the field of interference radiated by the house wiring and a worth-while increase in effective height.

Wider Frequency Response

A PROSPECTIVE builder of *The Wireless World* 2-RF Straight Set proposes to use the receiver almost exclusively for local-station reception with the best possible quality; "local" in this case implies at a distance of about 25 miles. He asks for advice as to how the audio-frequency range may be widened to meet his special requirements.

We suggest that the best way of extending frequency range in an upward direction is to flatten the response curve of the first intervalve coupling by connecting a fixed resistance of about 50,000 ohms in parallel with C6. A larger or smaller value of resistance may be tried; the final choice will be determined by the requirements of selectivity. In cases where interference is not likely to be present, a resistance across the tuned input circuit (C1) might also be tried. It should be unnecessary to introduce artificial loading across the third tuned circuit, as this is already damped by the diode.

It should be emphasised that the all-round usefulness of the set will be impaired by the change in question.

Calibrating a Milliammeter

A QUERIST, who wishes to increase the range of his milliammeter (0-10 mA) to give current readings up to about 150 mA, proposes to use the calibration circuit shown in Fig. 2. He asks us to suggest a course of procedure that will give a good measure of accuracy without recourse to a standard instrument.

By making a series of four successive doublings of the meter reading it will be possible to extend the range to 160 mA. The procedure is as follows: Gradually reduce the 1,000-ohm variable resistance from maximum until the meter reads 10 mA; then connect the shunt and adjust its resistance value until the reading falls to 5 mA (half scale). The meter will now cover 0-20 mA. Proceed in the same manner for the 40-, 80- and 160-mA ranges, adding a shunt at each stage.

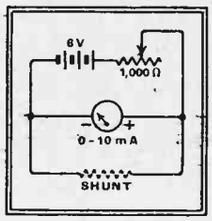


Fig. 2.—Adjusting the value of a shunt for doubling the range of a milliammeter.

As meters are usually most accurate at around full-scale deflection, the procedure outlined is preferable to one depending on readings at the lower end of the scale.

Finally, it should be added that the 1,000-ohm variable resistance, even if it could carry the current, would hardly allow sufficiently critical adjustments to be made on the higher current ranges; for these a resistance of lower maximum value should be substituted.

QPP on the Mains

AS a general rule so-called battery-economy output circuits are suitable only for the purpose for which they were designed, and are not adapted for feeding with anode current from the mains.

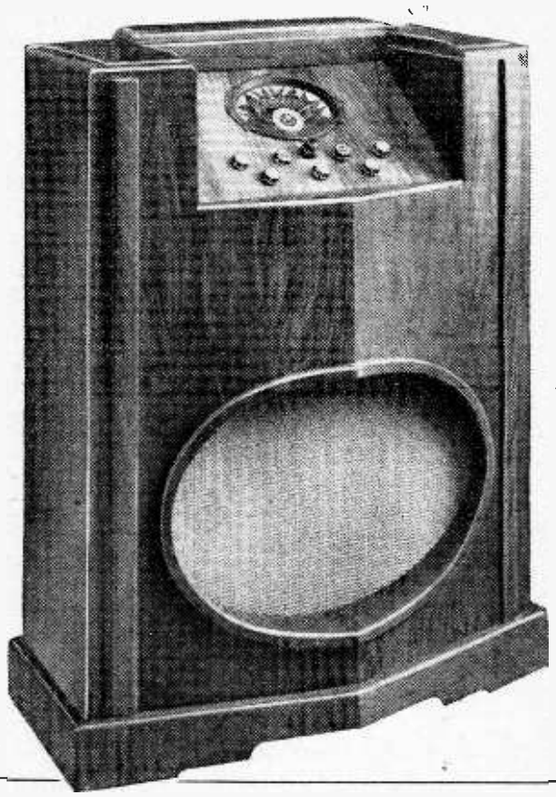
A reader whose house has just been connected to a mains supply has a very satisfactory QPP battery set, and, though realising the truth of the statement contained in the preceding paragraph, would like to feed the anode circuits temporarily from the newly available source of supply while he "makes up his mind as to what to do about a mains set."

As a QPP output stage requires an HT source of low impedance, any attempt to work the set in the obvious way from a mains unit will not be very successful. As a temporary measure we suggest that the bias of the output valves should be reduced to the normal value for Class "A" operation (about half the present figure) when the set may be satisfactorily fed from an ordinary H.T. unit. Economy in HT current will no longer be a matter of importance, and the obtainable output should be about the same as with the existing QPP system and battery feed.

Homeland MODEL 512

Combining the Best Features of Broadcast and Communication Type Receivers

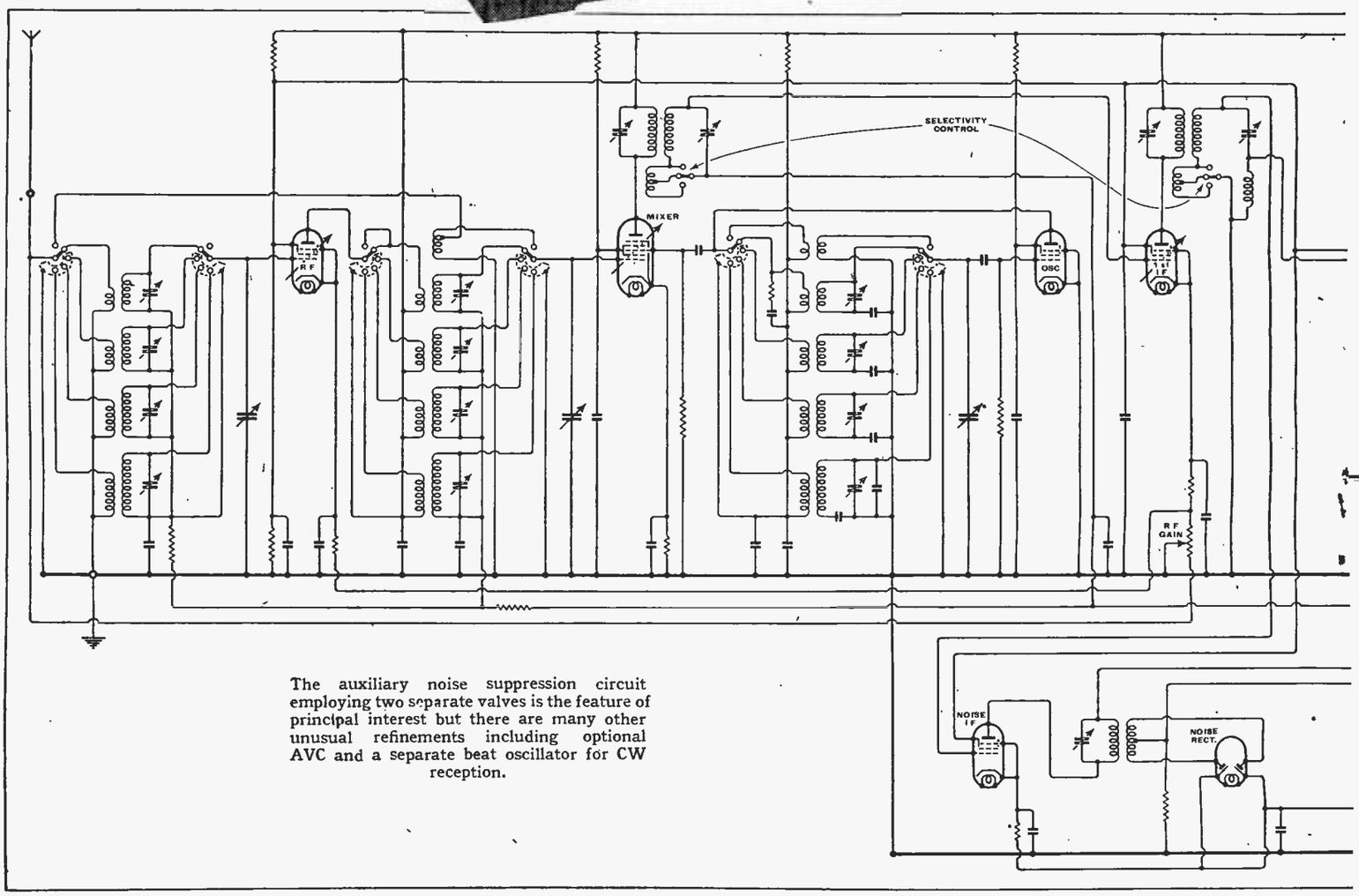
FEATURES. ***Waveranges.***—*(1) 6.8-20 metres. (2) 16.4-51 metres. (3) 48.5-177 metres. (4) 167-555 metres. (5) 732-2,140 metres.* ***Circuit.***—*(Principal valves): Pentode RF amplifier—pentagrid mixer—pentode separate oscillator—pentode first IF amplifier — pentagrid second IF amplifier—double-diode-triode second detector — push-pull tetrode output valves. Full-wave valve rectifier. (Auxiliary valves): Pentode noise suppression IF amplifier — double-diode noise suppression rectifier—triode beat oscillator.* ***Controls.***—*(1) Tuning. (2) Volume and on-off switch. (3) Waverange. (4) Variable selectivity. (5) RF gain. (6) Tone. (7) Noise silencer adjustment. (8) AVC and beat oscillator switch. (9) Beat frequency control.* ***Price.***—*(Chassis only, including valves) 25 guineas.* ***Makers.***—*Anglo American Radio (& Motors) Ltd., Albion House, New Oxford Street, London, W.C.1.*



THE specification of this instrument is one which is calculated to arouse the acquisitive instincts of the true wireless enthusiast whose interests embrace every phase of radio communication. For broadcast reception, ample power is ensured by the push-pull output valves operating under conditions giving an undistorted output of the order of 6 or 8 watts. Variable selectivity provides the degree of separation necessary for serious long-distance listening, or, alternatively, the band-width required for high quality local station reception. Ample magnification at both radio and intermediate frequencies is given by the signal frequency stage and two IF amplifiers, and particular attention has been devoted to the design of the short-wave tuning circuits.

In all there are five wavebands covering 6.8-2,140 metres, with only a small gap between 555-732 metres. Thus the listener can be assured of being in a position to receive every worth-while signal, including the sound accompaniment of television transmissions.

In addition to what may be regarded as the fundamental characteristics of the receiver there are a host of features that give the set the character of a professional communication instrument. Of

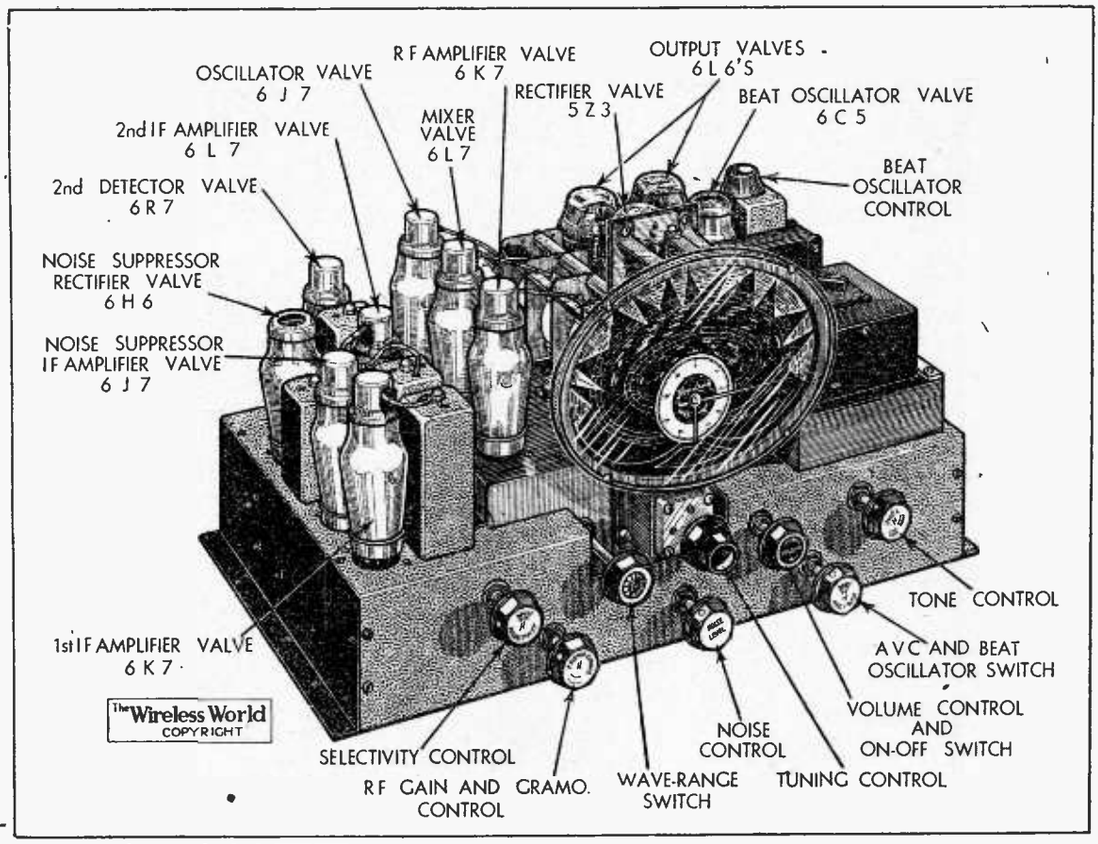


The auxiliary noise suppression circuit employing two separate valves is the feature of principal interest but there are many other unusual refinements including optional AVC and a separate beat oscillator for CW reception.

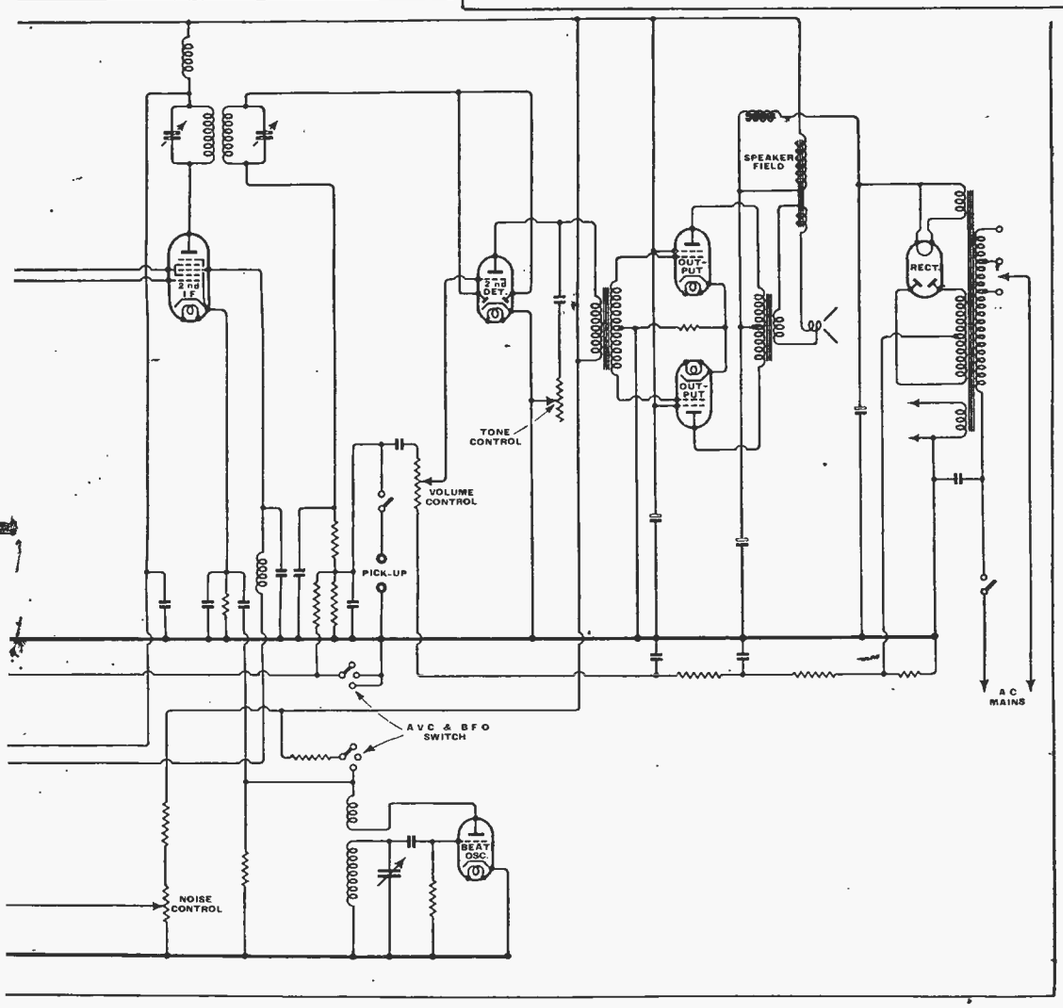
these the special noise suppression circuit, the beat frequency oscillator and the optional AVC control may be cited as examples.

The circuit starts with an RF amplifier which is operative on four out of the five wavebands. The function of frequency-changing is performed by a separate pentode oscillator in conjunction with a pentagrid mixing valve. There are two IF stages operating at 456 kc/s, the first of which employs a variable-mu pentode with Ferrocart IF transformers incorporating a third winding controlled by a three-position switch to give three degrees of selectivity. An RF gain control is included in the cathode circuit of this valve and is coupled with the cathode return of the RF amplifier and a shunt across the aerial input.

The second IF stage makes use of a pentagrid valve which is controlled by a supplementary quick-acting AVC circuit of the type due to Lamb and described in the issue of this journal for March 27th, 1936. For this purpose an auxiliary IF amplifier and push-pull diode rectifier are included and there is bias adjustment for the diode to bring the operating conditions to the required point. The theory of action is briefly that the auxiliary AVC circuit is inoperative until the peaks of the interfering noise exceed the level of the signal. When this condition arises the auxiliary AVC circuit comes into operation and instead of, say, a switch click there is a momentary period of silence which causes far less interference with the intelligibility of the signal.



The radio-frequency tuning unit occupies the centre of the chassis and includes the first three valves in the circuit. Detachable metal shields, with direct contact to the earth pins in each case, are provided for all valves carrying high-frequency currents.



The cathode circuit of the second IF amplifier is also coupled to a separate beat frequency oscillator valve which will be found of value for the purpose of locating and tuning weak signals, particularly on the short-wave ranges.

A double-diode-triode with parallel diodes is used as second detector and provides simple automatic volume control without delayed action. The AVC circuit can, if required, be switched out if the highest degree of sensitivity is required on weak stations. A tone control is connected across the anode circuit of the triode amplifier section of this stage, and as the pick-up is introduced at this point the tone control is operative both on radio and gramophone.

Transformer coupling is employed between the first AF stage and the push-pull beam tetrode output valves. The generous output from these valves and the clear-cut reproduction free from harmonic distortion are the outstanding impressions left after an extensive test of the receiver. The loud speaker was a Mag-

Homeland Model 512—

navox Type "55," and its curve-sided cone was able to take anything which the output stage could give it without showing any tendency to develop sub-harmonics. Pianoforte music was unusually realistic at the natural level of a concert grand instrument, but other types of transmission were hardly less impressive from the quality point of view.

For ordinary broadcast listening the fine array of "organ stop" controls need cause the uninitiated no misgivings, for out of a total of nine controls, six may be preset and the receiver operated with the usual minimum of three controls, namely, tuning, waverange and volume. On medium and long waves every worthwhile station was received with a handsome margin of amplification in hand as judged from the setting of the RF gain control. With the receiver adjusted for maximum selectivity less than one channel was lost on either side of the London Regional station when operating the set in Central London—a performance rarely achieved by any of the sets which pass through our hands.

Flexibility of Control

The short-wave performance, if not markedly superior to that of the average all-wave broadcast set with an RF stage, is capable of much greater flexibility of control. On the ultra-short-wave band good sensitivity was noted in the 10-16-metre region, but the exceptionally strong signal from the Alexandra Palace brought in a certain amount of modulation hum.

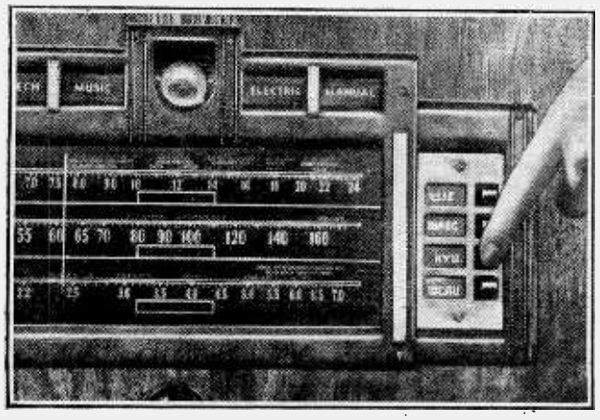
In spite of the additional pre-selection resulting from the introduction of the RF stage on the other short-wave ranges, second channel repeat points were sufficiently marked to call for comment. On the other hand, no trace of microphony was observed on any of the short-wave ranges in spite of the fact that the condenser mounting is rigid. The fact that the loud speaker was mounted on a separate baffle no doubt contributed to this good result.

The operation of the noise suppression control will be for most people a new and interesting experience. At first its action is somewhat baffling, but one soon discovers that most of the good work is done in the vicinity of a cut-off point which is reached by gradually turning the control down in an anti-clockwise direction. The critical point is indicated by interruptions in the modulation and finally complete silence and the correct operating position appears to be that which is just sufficient to maintain continuous operation. With strong signals there is little change in the relative levels of modulation and background noise, but on very weak stations a decided improvement in the programme value occurs just before the cut-off point is reached.

The beat frequency oscillator appears to be of just the right strength, and in the absence of a tuning indicator will be found of great value when locating and tuning in feeble transmissions.

A cathode-ray tuning indicator is available as an accessory and an auxiliary indicator may also be fitted in the noise silencer circuit. The price of these additions is 21s. in each case. The basic price of the chassis is 25 guineas or 28 guineas with the Magnavox loud speaker. The set is also sold in a range of cabinets of attractive design and the single speaker console illustrated in the title of this review costs 39 guineas.

FOOTNOTE.—As we go to press the makers inform us that from January 1st, 1938, the output stage will be modified to include negative feed back and that an undistorted output of 16 watts may be expected. This improvement will be of special concern to those interested in the twin-speaker consoles.



PUSH-BUTTON TUNING.—Some of the newer RCA (American) sets are fitted with an alternative push-button tuning system whereby any one of eight stations (determined by the purchaser when the set is installed) may be tuned in. Other stations are receivable by manipulation of the condenser knob in the ordinary way. An external press-button control unit, connected to the set by a flat cable, allows the pre-selected stations to be tuned in from a remote point.

Germany's Broad-Band Cables

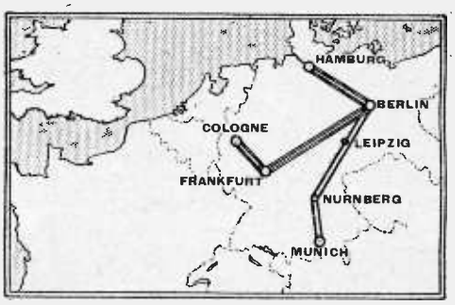
LINKING UP POST OFFICE AND TELEVISION STATIONS

SINCE the opening of the world's first high-definition television-telephone service between Berlin and Leipzig on March 1st, 1936, the German Post Office have further developed the broad-band cable system employed, and now announce that the practical tests have been fully up to the expectations of the theoretical calculations.

Broad-band cables are highly important for linking Germany's television stations. At the same time the Post Office desire to provide television-telephone facilities, and they have made arrangements for sending as many as two hundred telephone conversations along the new cables in the frequency band not required by the television images.

The cable from Berlin to Leipzig has been extended to Nürnberg and to Munich. The line from Berlin to Hamburg is nearing completion, and the cable from Berlin to Frankfurt and Frankfurt to Cologne is under construction.

Television at 441-line definition and 25 interlaced frames will require repeaters every 10-12 miles along the cable. These repeater stations will be entirely unattended. Current to feed them will be passed along the cable at 50 c/s, and signal impulses for starting up the amplifiers will be sent along at 5,000 c/s. The 200 telephone conversations will be branched off and only passed through every second repeater, whereas the television image which occupies 1,000 kc/s to 4,000 kc/s will pass through them all. It is hoped that the cables with their complement of repeaters will be completed in the course of 1938. At the moment only 180-line television has been passed by cable



Existing and proposed extension of the broad-band cable links between German cities.

from Nürnberg to Berlin, and this only requires 1,300 kc/s. Work, however, is already well advanced.

Three types of cable are used, made by three different firms: AEG, Felten and Guilleaume, and Siemens. Each of these has a core of 5 mm. and a co-axial return line of 18 mm. diameter, the damping factor is practically the same for each make.

Interference from outside is still found under 100 kc/s, but otherwise the cable is perfectly silent except for the usual thermal agitation. The Rugby (350 kW), Königswusterhausen (50 kW), and Warsaw (200 kW) stations only produce the negligible interference of one-thousandth of the signal voltage, so that the cable can be considered entirely trouble-free and silent.

Fuller technical details of the cable system, which are perhaps more interesting to line specialists than to wireless amateurs, have been published in an article by K. Höpfner and H. F. Mayer, "Stand der Breitbandtechnik in Deutschland," in No. 46 of *Europäischer Fernsprechdienst*, 1937. This article gives the latest details, exact diagrams and photos.

A. A. G.

Ambitious Amateur Station

Refinements at G2AJ, Bristol

By G. H. BOWDEN, A.M.I.E.E.

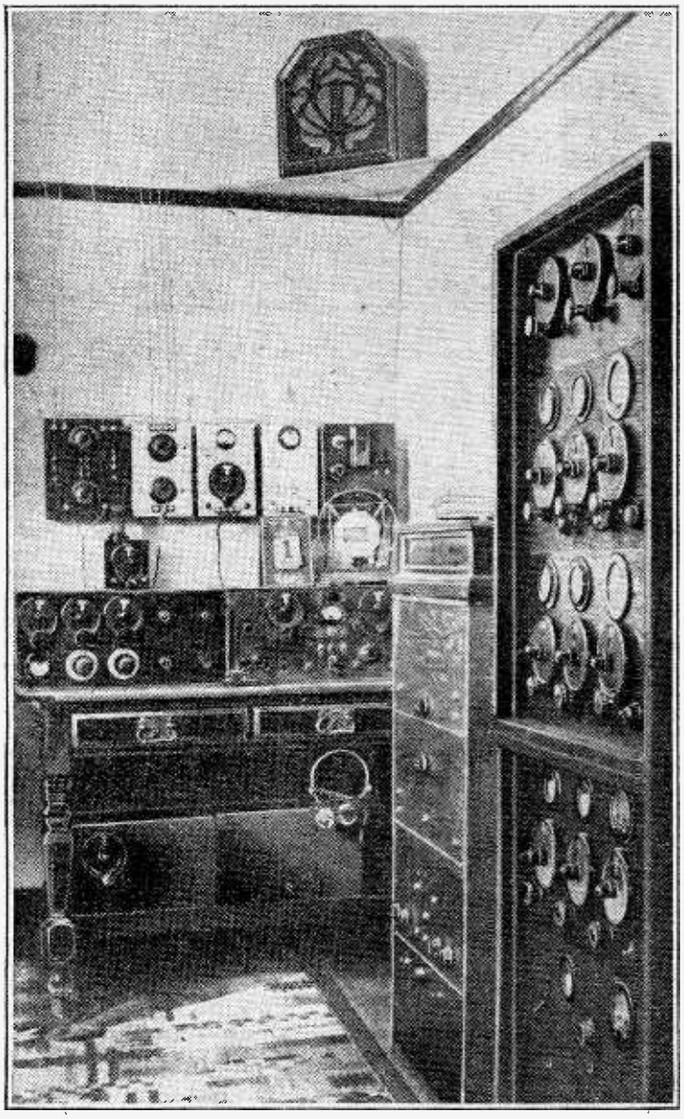
THIS is a description of an amateur station such as is heard by many listeners on Sunday mornings, but which has a few features which are rather unusual. This article is written in the hope that it may bring to the minds of those not connected with the amateur radio movement the possibilities of low-power wireless communication.

The equipment consists of three transmitters, receiver, control and monitor unit, auto-carrier control unit, line amplifier, line tone sender, direction-finder, and an electron-coupled wave-meter.

The transmitter assembly is seen on the right of the large photograph. The bottom deck houses vacuum-type valve rectifiers for supply to sub-audio stages of the modulator, the sub-radio frequency stages of the radio-frequency amplifier, the grid bias supply to the radio-frequency amplifier, and a further rectifier for the 500-volt anode supply to the RF output stage and AF output stage; this makes four rectifiers in all. The next deck above carries a three-stage AF amplifier using two RC-coupled stages and one transformer-coupled stage working into a modulator valve that can be transformer-coupled at will to either of the three transmitters mounted above it by means of switches. This switching, like the rest of the equipment, is so arranged that no voltage recognised as dangerous is accessible. Each transmitter is of identical construction and is interchangeable, using, by the way, valves of British make in contradistinction to the common state of affairs, and has a crystal oscillator stage acting as either a buffer amplifier or as a frequency doubler. This second stage is again capacity-coupled to a power amplifier stage, each stage using only one valve. The input to the last stage is 10 watts on 169 metres, and 25 watts on both 84 metres and 42 metres, this input being modulated by the modulator already mentioned.

The output of any one of the transmitters can be coupled by means of slotted link connectors to the topmost deck, on which is mounted series and parallel tuning condensers together with an aerial tuning coil, thus enabling the transmitter to work into either a Marconi single-wire aerial or tuned transmission line, employing either link coupling or direct taps on to the PA inductances via isolating condensers at the tapping points. Hot-wire ammeters incorporated in the aerial circuit are mounted on the output terminals at the top of the assembly.

The receiver is a six-stage superheterodyne compartmented with one stage per compartment, which has two signal frequency stages, two intermediate-frequency stages, a second detector, and power amplifier output stage. The heterodyne is injected via an auxiliary grid in the first detector, and all radio-frequency amplifier stages are controlled by grid bias derived at will from either a resistance in the negative HT supply lead or from a Westector coupled to the second detector for AVC. A built-in valve rectifier supplies anode current, but battery supply is used for filament heating.



General view of the station, with the triple transmitters in the foreground.

Alongside the receiver can be seen the monitor and control unit, which incorporates a zero-beat oscillator, a diode output meter, a heterodyne oscillator for checking frequency and stability of received signals. This oscillator also serves, in conjunction with a single-valve receiver, of which the tuning dial can also be seen on the control unit panel, to check the output of outgoing transmissions. The microphone transformer is also built into this unit together with a tone generator and the necessary gain control and jack points to enable gramophone records announcing the station call-sign to be used while the transmitter in use is being adjusted under modulation. A single milliameter with meter switch serves to check and measure operation of the incorporated units, which are all removable, and also to measure the output of a diode mounted on the modulator deck and so help maintain a steady audio voltage on the grid of the modulator output valve. A metal rectifier in conjunction with a neon stabiliser supplies both HT voltage and microphone excitation current, in addition to supplying the relays in the receiver and transmitter. All switching is done from the control unit; one switch controls the relay giving power from the mains to the transmitter, another serves to switch on the receiver, and a further double-throw multi-contact switch serves to put the transmitter on the air for telegraphy in one position or telephony in the other position. Relays in the transmitter effect the control of the HT anode supplies to the radio-frequency stages and to the modulator output stage, and also switch in a relay for keying by means of the grid blocking method; to short-circuit the modulating transformer there is a further relay for cutting off anode supply to the receiver valves.

When CW telegraphy is being received the receiver output is connected to a trigger amplifier which serves to control

Ambitious Amateur Station—

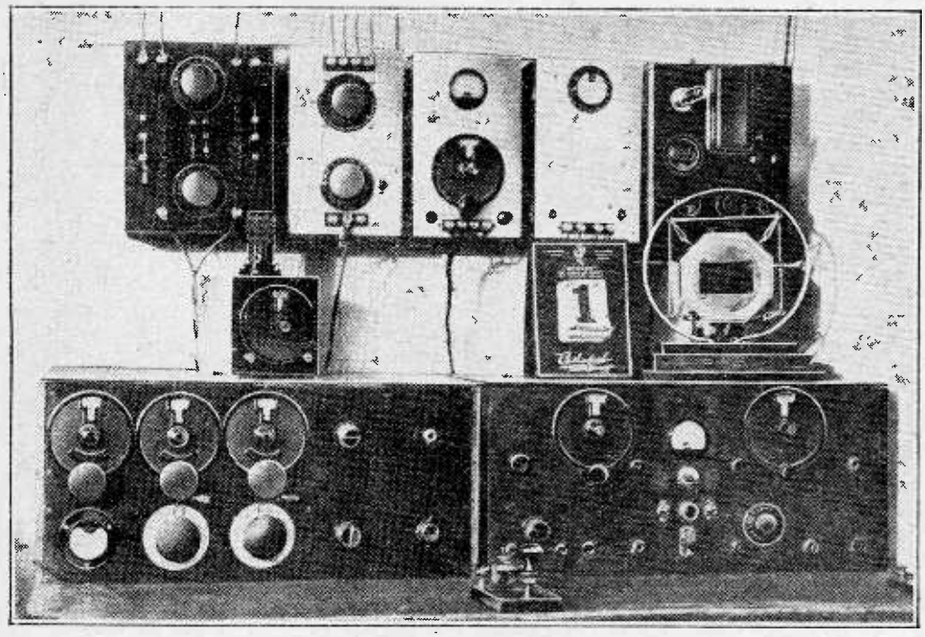
the grid bias of a line amplifier connected to a tone generator, thereby enabling transmissions with bad notes to be read more easily.

A voice control unit incorporating two trigger amplifiers, one for reception and one for line input, permits transmission and reception to be carried out from any point over a two-wire telephone line, suitable variable delay or hang-over being introduced to prevent cut-off during short pauses in speech. The operation of the relay is very quick, and, contrary to what one might expect, no difficulty is experienced on account of the inevitable loss of the first syllable of the first word uttered when replying.

This additional equipment can be seen on the right behind the transmitter; it is coupled via a multi-core cable to the control unit.

On the wall above the receiver will be seen the receiving aerial switchboard, next to it the direction-finding radiogoniometer which works in conjunction with two Bellini Tosi loops; next, again, is the electron-coupled wavemeter, while a battery-charging panel and a power panel are on the extreme right.

The station, installed in an ordinary suburban house in a normal suburban district, can be operated without any interference being caused even to the broadcast receiver within the house. Energy from the transmitters is fed through a forty-foot transmission line to a sixty-five-foot aerial, one end of which is fixed to the chimney and the other to a forty-six-foot pole in the garden.



Close-up photograph of the receiving and control equipment.

RANDOM RADIATIONS

By "DIALLIST"

Scophony Television

ON a recent evening I was able to attend a demonstration of reception by the Scophony process of the television programme from the Alexandra Palace. Two receivers were in use simultaneously in a hall hardly big enough for the two hundred or so people who were packed into it. One receiver's screen was about 5ft. by 6ft.; the other's 24 inches by 20. I was, personally, more interested in the smaller receiver, which is actually the model intended for home use. The bigger one is designed for theatres, and so on. First of all I'd like to say that the direct reception from A.P. was far better than that between studio and studio over a cable, which I saw rather more than a year ago. It was also a considerable improvement on what was shown during the summer at the Science Museum Television Exhibition. The illumination was good and the definition quite satisfactory. We were warned that there might be some wobble, it being stated that the B.B.C.'s new synchronising signal transmitting apparatus was still in the experimental stage. The images, however, were remarkably steady on the whole and only once or twice was there a loss of sync. for a second or two.

No High Voltages

During the demonstration I managed to get hold of one of the engineers, who gave me some interesting information about the home receiver. One of its outstanding points, to my mind, is that the highest voltage in any circuit of the receiver is only 280. I have always had a feeling that voltages of the order of 2,000-3,000 were not exactly desirable in a domestic electrical appliance. What the requirements of the home model are in the way of current, I do not know; but I don't imagine that the load is at all out of the way. I learned that Scophony have no intention of going into immediate production, at any rate, on a large scale. And there I think they are wise. They realise that public interest in television as a form of entertainment cannot grow very rapidly until the programmes become very much better than they are now. The one that I saw that evening was very poor stuff; had I been "looking-in" purely for entertainment, I'm sure I should have switched off pretty early in the proceedings.

An Old Catalogue

LOOKING through some old books and papers just now, I fished out from amongst them an old wireless catalogue. It is not dated, but from internal evidence it must be for about 1928. Flicking over the pages I came to a list of HTB's. A first-grade standard-capacity battery, 99-108 volts, then cost 21s. A "cheap" battery which had just begun to make its appearance was fixed at 8s. 6d. for the 66-volt size and 13s. 6d. for that of 102 volts. Grid bias batteries of 9 volts apiece cost 1s. 6d. to 2s. It was not very long after that that there was a perfect spate of what we then thought very cheap batteries, and my laboratory records show how nasty they were. One brand in particular was advertised as being specially designed for long service life under a load of 10 milliamperes. Four of them were placed under this initial load and run for three hours daily. The first to "go" touched half its original voltage on the fourteenth day and the longest-lived survived for just three weeks! Modern mass production methods have made it possible to turn out good batteries at about half the price of those days and poor ones at almost any price. But the difference in their performance is as marked as ever.

When Prices Were Prices

Here are a few other items from this catalogue of but nine years ago. The cheapest three-gang variable condenser cost 36s., which did not include slow-motion drive, or even a tuning dial at all. A high-quality variable condenser with direct "edgewise" drive cost 55s. in two-gang form and 82s. in three-gang. The Pye 5-valve portable of that date was fixed at 30 guineas and the 7-valve G.E.C. at £40. A 2-valve AC mains table model by Gambrell appears in the list at £22 5s. The cheapest valve was then the old bright-emitter "R," which had come down to 5s. In the whole list of valves, which runs to 157, including small transmitting valves, there are only 6 which are not triodes or mains rectifiers. These six are screen-grid valves, the first of which, the old S625, burst upon us at the Radiolympia of 1927. There is no mention of a mains SG valve: all of those shown in the list are for battery operation and the price of all is 22s. 6d.

The Battle of the Voltages

That old catalogue with its lists of bygone valves brought back to mind the warfare that raged for years over the question of the best filament voltage for battery valves—and even in 1928 the great majority of valves *were* battery valves Of the 157 in the list only 21 are AC mains triodes, and 12 mains rectifiers. In the beginning, if you remember, all valves were of the 4-volt variety. The original "R" and it subsequent rivals, the Mullard Ora and the Cossor "tin-hat" valves, all needed 4 volts and passed from 0.5 to 0.7 ampere of filament current—2.8 watts for the filament of one valve, about twice as much as a whole 6-valve battery superhet calls for nowadays. The first dull-emitter was the DER, rated

Random Radiations—

at 1.8 volts, 0.25 amp. Then came the "06" valves, which had a very short vogue —and life!—since their thin filaments were so liable to break, as well as being dreadfully microphonic. The dull-emitter passing 0.1 ampere succeeded then and for some time it was made in 6-volt, 4-volt and 2-volt types. The 6-volt valves were undoubtedly the most efficient, but the 2-volt were the most popular since they required only a single-cell accumulator.

The Valve That Made History

All those who valued quality of reproduction, such as it was in those days, plumped for the 6-volt valve, because that class was the only one to include a power valve worthy of the name. For the fortunate few who could afford to be prodigal of both LT and HT current, output valves such as LS5 and LS5A gave splendid results. Both of these were rated at 4.5 volts, 0.8 amp. We ran them from 6-volt accumulators, adjusting the filament voltage by means of rheostats. There were also smaller, but quite reasonably efficient 6-volt and 4-volt output valves. But there was really no power valve worth talking about in the 2-volt class, and for this very reason there were many who believed that the 4-volt valve would win the day, since it seemed to provide the best compromise. It was when Marconi-Osram launched the P.2, the first real 2-volt power valve, that the defeat of the 6-volt and the 4-volt battery valve became certain. Maker after maker began to concentrate on the 2-volt range, and soon the 2-volt valve stood alone.

America Likes Automatic Tuning

IN the United States, sets with automatic, or "telephone-dial," tuning are all the rage this season. That this might happen was predicted in the bulletin of the Institution of Radio Engineers some time ago. Readers may possibly remember that I had something to say at the time about an article in the bulletin, whose author had the foresight to grasp that the development of ATC meant that automatic tuning could be made a feature of radio sets and that, therefore, something entirely new could be offered to the public. He was right: the American public has given its vote for receiving sets in which any one of a dozen stations can be brought in almost instantly by means of a dial very like that used on automatic telephones. Sets which have not this feature are regarded as out of date. The listener has been presented with a real reason for buying a new receiver. Some of the automatic systems are just "eyewash," as I told you a week or two ago; but others, employing small electric motors, are highly ingenious. Anyhow, automatic tuning has come to stay.

Why Indoor ?

I KNOW that wireless *should* be an outdoor hobby, for it is in other countries, notably the United States. Over there the number of car radio sets has reached gigantic figures, though with us the motor car which has a built-in wireless receiver is comparatively rare. You will find, too, that not many people nowadays take portable wireless sets with them when they are having picnics in the country or spending the afternoon afloat either on the sea or on this river or that. And why? Well, not to mince matters, the B.B.C. is largely to blame. The Little Nationals, except the Scottish, are closed down; many car radio sets don't cover the long waves, and if they did, all that they could bring in from Droitwich would be talks for schools. All that remains is the main Regional programme, which is usually much of a muchness during the afternoons. In other countries you can be sure of good entertainment at any time if you install a car radio set, or take a portable with you when you fare afield. Here it's a case of take it or leave it—and so poor is the selection available that outdoor listeners are often content to leave it.

News from the Clubs

Southall Radio Society

Headquarters: Southall Library, Osterley Park Road, Southall.
Meetings: Tuesdays at 8.15 p.m.
Hon. Sec.: Mr. H. F. Reeve, 26, Green Drive, Southall.

Mr. H. C. Spencer, who lectured recently on the subject of receivers, traced the development of the modern superhet from the earliest stages. In his lecture on the suppression of electrical interference, Mr. H. J. Walters, of the Belling and Lee technical staff, gave a practical demonstration by suppressing a very persistent form of interference coming from an electric fan.

Wirral Amateur Transmitting and Short-wave Club

Headquarters: Beechcroft Settlement, Whetstone Lane, Birkenhead.
Meetings: Second and last Wednesday evening in each month at 7.30 p.m.
Hon. Sec.: Mr. J. R. Williamson, 18, Harrow Grove, Bromborough, Birkenhead.

At a recent meeting Mr. W. E. Corbett gave an interesting account of his experiences as an Army operator and as the first amateur transmitter in Egypt. One of the lecturer's early transmitters derived its power from a stationary "bicycle" pedalled by a native. It was, said the lecturer, very difficult to induce the native to pedal at a uniform rate.

Kingston and District Amateur Radio Society

Headquarters: Three Fishes Hotel, Richmond Road, Kingston.
Hon. Sec.: Mr. D. N. Biggs, 44, Pooley Green Road, Egham, Surrey.

The editor of the *Short-Wave Magazine* and Mr. Jonah Barrington, of the *Daily Express*, were present at the Club's December lecture at which Mr. Allen demonstrated the "Evrizone" single-signal superhet. The next meeting will be on January 5th, at which a lecturer from the Premier Supply Stores will talk on amateur equipment.

Surrey Radio Contact Club

Hon. Sec.: Mr. A. B. Wilshire, 14, Lytton Gardens, Wallington.

Despite the thick fog a large number of members attended the annual dinner held at the Café Royal, Croydon, recently. A leading feature of the evening was a draw for several valuable wireless prizes.

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8.0 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

The gramophone evening, at which Mr. G. A. Hoskins, the vice-chairman, presented an excellent programme of records, was highly appreciated. The dearth of really tuneful light music of the musical comedy type was glaringly apparent when comparisons were made between to-day's efforts in this direction and those of pre-war days. The next meeting will be held on January 11th, at which the subject of the lecture will be "Ultra-Short-Wave Apparatus Used in Television."

Slough and District Short-wave Club

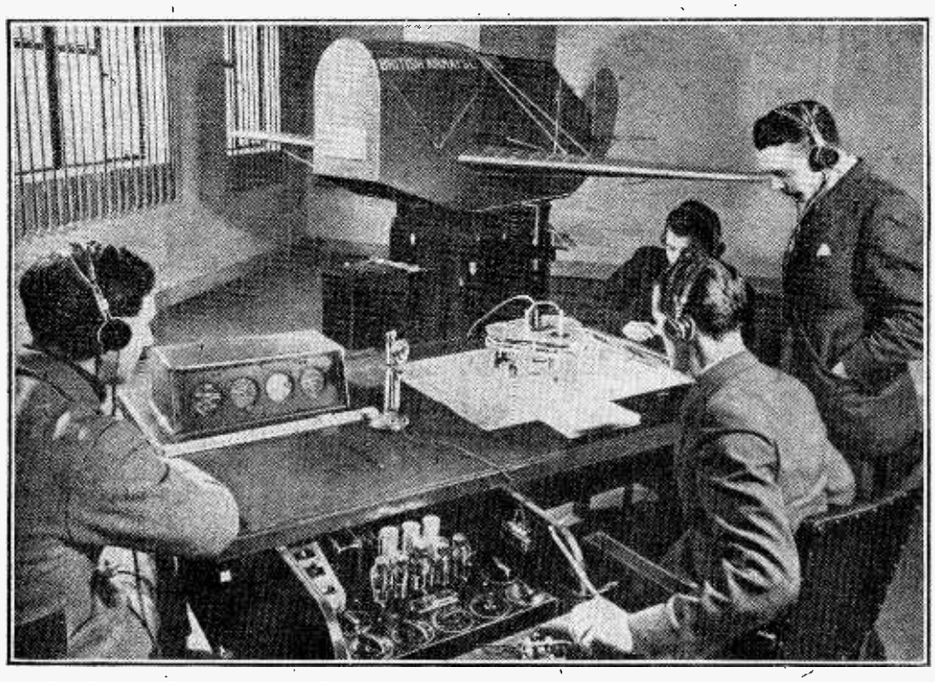
Meetings: Alternate Tuesdays at 7.15 p.m.
Hon. Sec.: Mr J. H. White, 20, Chalvey Road, East, Slough, Bucks.

There are now thirty members of the Club, which was formed in July. For the benefit of beginners a series of lectures is to be started on the fundamentals of radio.

Bradford Short-wave Club

Headquarters: Bradford Moor Council Schools, Leeds Road, Bradford.
Meetings: Fridays at 7.30 p.m.
Hon. Sec.: Mr. S. Fischer, 10, Highfield Avenue, Idle, Bradford, Yorks.

At the last meeting Mr. Simpson (2BXS) gave a very interesting talk on his low-power telephone transmitter which he brought along with him.



FLYING BY METER READINGS. Any type of exercise in blind flying including landing with the aid of the Lorenz beam system can be devised for pupils in the latest Link training machine. The effects of manœuvres are indicated on the pilot's instruments by electrical means, and a cumulative record of every movement he makes is made by the small three-wheeled trolley which inks a trace on the chart on the instructor's desk.

UNBIASED

Do Manufacturers Want Money?

I SUPPOSE that, like myself, most of you are afflicted with the curse of Adam (I am referring, of course, to the necessity of working for a living and not to his other trouble). Needless to say, I am quite aware that there are a few of you who are under no necessity of earning your daily bread, but who work for the sheer love of it. There is, however, no need to worry about that as there are eccentric people even in the best regulated families.

The majority of people are, however, obliged to earn their daily caviare, and even wireless manufacturers, when stripped of their lofty ideals, really make and sell sets in order to keep the wolf from the door. This being so, you would think that manufacturers would strain every nerve to avoid waste and inefficiency in order to make as much money as possible with the least possible amount of work, just as more humble fellows like you and I do. Strange to say, however, this is very far from being the case as anybody with half an eye can see clearly. To prove my point it is only necessary to consider manufacturers' expensive ideas in regard to radio-gramophones, more especially those fitted with an automatic record changer.

The extra entertainment provided by a gramophone is most needed by the relatively poor man who cannot afford to pay for a seat every evening to hear the wealth of entertainment which others enjoy. Instead he can obtain this music comparatively cheaply on gramophone records. Yet radio-gramophones have usually been sold in conjunction with the most expensive radio chassis manufacturers produce instead of with the cheapest, as should be the case.

Expensive ideas with regard to radio-gramophones.

Now consider the question of record changers. As most people are aware, the most prolific users of wireless are womenfolk, and the time when they use it is during the day when they let the set drool away all day to the accompaniment of whatever they are doing. For the most part, daytime programmes are reasonably good as the B.B.C. simply daren't try to foist on the women any of the stuff they reserve for us mere men in the evening. At times, however, there are bad programme patches even during the daytime, and it is here that the automatic record changer would really step into its own if it were available in conjunction with an inexpensive receiver.

$\sqrt{-1} = ?$

I HAD occasion recently to draw attention to the mysterious working of the technical highbrow's mind which searches for obscure causes in order to explain certain happenings when the true reason lies right under its nose, if, indeed, a mind has a nose. As a proof that I am not the only person to suffer from these exasperating traits in the highbrow's mental processes, I have received several letters from readers giving similar instances of this sort of thing which they have experienced themselves.

There is one letter in particular to the contents of which I feel I ought to give a certain amount of publicity, since the highbrow in question does, I understand, condescend so far as to contribute to *The Wireless Engineer*, which, as you probably know, is the happy hunting ground of these sort of people.

It appears that my correspondent's set developed a fault which on the face of it seemed a very peculiar one indeed. In brief, it functioned admirably during the daytime, bringing in stations from far and near with wonderful volume and clarity, but, at the going down of the sun, it emulated the example of the beasts of the field and went on strike until daylight appeared once more, when it was as chirpy as ever. It was a well-known mains superhet, and had been bought by my correspondent for use in a new residence into which he had just moved.

The dealer from whom it was bought suggested that the trouble was merely one of those intermittent faults which we hear so much about, although it seemed rather remarkable that these intermittent fits of the sulks should always commence at the same time of day. Instead of accepting the dealer's offer to change the set, my correspondent very foolishly decided to consult *The Wireless Engineer* highbrow.

Needless to say, the highbrow was not stumped for a moment, but immediately began to work out an elaborate theory of the existence of an entirely new Appleton-type layer in order to account for these mysterious results. In fact, he got quite excited about his supposed discovery, and filled page after page with figures to prove his point. The layer, he said, was probably a purely local one, only affecting certain districts. All was ready, in fact, for the reading of a truly elaborate paper on the subject before a certain learned society when the bottom was blown out of the whole business by the next-door neighbour, who happened to hear of the trouble.

The cure suggested by the neighbour was a very simple one, namely, to move

By FREE GRID

the mains tapping on the power transformer from 240 to 230 volts at sunset. Curiously enough, the man who suggested this perfectly correct cure said that he had learned of it by perusing a note which I wrote in this journal some years ago under the title of "The Old Geeser's Geyser," concerning the big voltage drop along the feeder cable to a certain new housing estate when all the lights were switched on in the evening. Such a voltage drop is, of course, quite sufficient to

Mysterious workings of the technical highbrow's mind.

cause the oscillator of a superhet to stop doing its stuff, thus cutting off reception as completely as though the set had been switched off.

Sensible New Year's Greetings

THE arrival of an eviction notice has reminded me that once more the old year, with all its triumphs and disasters, is drawing to its close, and I must, I suppose, fall in with popular convention and wish you the very best of good fortune and happiness in the coming year. It is, however, with very great reluctance that I join in these good wishes, not because I have not very warm feelings of friendship toward you, for indeed the opposite is the case. The reason is simply that I think it a truly shocking thing that in this scientific and mathematical age, and above all associated with a scientific journal like *The Wireless World*, there should be found people, no matter whether readers or staff, who actually think that it is still possible, by mere words, to change all the great laws of Nature which order our lives. Let us, at any rate, make some small attempt at being properly scientific if we must continue with these relics of the Dark Ages. I therefore take this opportunity of wishing that in the New Year you may obtain a supply of CH_3OH sufficient to bring your *cocles cordis* to the degree of warmth necessary to bodily health—98.4°F., I believe.

Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

Droitwich Quality

I WAS naturally interested to read in your issue of December 9th Mr. Cotterell's reply to critics of the Droitwich transmissions, including myself. Unfortunately, it does not help to explain why he disagrees with us. There is much to explain, and Mr. Cotterell may be interested to hear my attempt, though it is rather unkind to him.

First, I should outline the observation on which my previous remarks were based. My receiver is pretuned, using an R.F. stage and diode detector, with two tuned circuits. The tuning is so flat that sideband cutting is not apparent even on the long waveband —at least, Mr. Winder's criterion of a strong whistle on Droitwich is satisfied. I have, moreover, been unable to improve the quality or increase the strength of this whistle by damping the aerial circuit or replacing it by a resistance as Mr. Cotterell suggests. I believe the lack of sideband cutting to be due to the extreme stability of the Colebrook double triode HF stage used.

A direct switch over from London Regional to Droitwich when both are taking the same programme from a London studio shows a startling difference. Moreover, it does not appear to be a simple loss of top. In the Droitwich version sibilants in speech not only lose their sharpness, but also acquire a definitely "mushy" quality. It has been suggested to me that this is due to "peaking up" on land-line amplifiers.

To explain why Mr. Cotterell finds no fault with the Droitwich as compared with the Midland Regional transmissions, I can only suggest two considerations as relevant. (1) The Birmingham studios are considerably farther from Droitwich than Brookmans Park is from Central London, and the Midland Regional transmissions may not be above reproach on account of land-line losses. (2) Variations in the 7-10 kc/s region may be masked by the 5 kc/s peak of his Hartley Turner twin cone speaker, as shown in the response curve published on July 3rd, 1936. The curve of the Voigt speaker, published on March 29th, 1935, is much flatter in the top. I think a direct comparison of these axial curves is fair, though I appreciate that neither represents the average performance of the unit concerned, especially in view of the top distributing arrangements of the Voigt horns used by Mr. Cotterell and myself.

Maidenhead. W. J. CLUFF.

Big Ben Chimes

I WAS very interested to see the letter from Mr. J. M. S. Adams in your issue of December 2nd, as I also heard the rather peculiar effects referred to by this gentleman, and I think I can offer a feasible explanation for the phenomenon.

I also switched on before five o'clock that afternoon and heard the bona fide chimes of Big Ben striking the hour. Then came the announcement, followed by the obviously recorded chimes of Big Ben striking one, and this was repeated again, to be followed by a period of silence, and then Bow Bells. I think I am right in saying that Henry Hall was broadcasting from Newcastle on that afternoon, and doubtless there was a hitch in the land-line circuit somewhere. This would explain the belated start of the programme. As for the recorded chimes of Big Ben, these were used several times by the B.B.C. to introduce broadcasts by certain famous dance bands. I hope that this explanation will be of interest to your correspondent.

Regarding Mr. Adams' query as to whether we ever hear Big Ben himself or only recordings of his chimes at the appropriate times, I think I am safe in saying that the B.B.C. never fakes a time signal. My radio set is not a super one, but the quality of reproduction is fairly faithful, and I believe I can always differentiate between a recording and an actuality broadcast. The B.B.C. recordings are excellent, but I think there is always at least a slight hiss or other distortion which gives the clue. Incidentally, I thought the recording of Big Ben's chimes referred to was hardly up to standard.

Hounslow, Middlesex. L. J. FRYER.

RC Paraphase Coupling

I ENTIRELY agree with the remarks of "Nauticus" in your November 4th issue regarding the merits of RC paraphase coupling and transformer inter-valve coupling.

In my opinion, RC coupling (paraphase) produces very pronounced distortion when very slightly overloaded (due to grid current charging the coupling condensers), but with transformer coupling the result is far more pleasant.

Apart from the above merits the quality obtained by RC paraphase system is not one bit better (if as good) as when a really first-class inter-valve transformer is used, in any case, it is useless to have technical advantages if it is impossible to *hear* the result.

Manchester. J. A. HARTLEY.

Police Wireless

IN connection with your article concerning the Brighton Police Pocket Set, mentioned in *The Wireless World*, No. 952, it may be interesting to your readers to know that this type of receiver was developed by me during the "super-regenerative" craze of 1923-24, and was designed especially for 600 metre marine reception and broadcasting; later it was adapted for police use, with the call device added.

My original receiver, which is slightly smaller than the police type, is still in working condition, and after all these years retains its original sensitivity.

With our present-day knowledge of short-wave practice it should not be difficult to improve the "old timer."

Twickenham. FRANK DEAN.

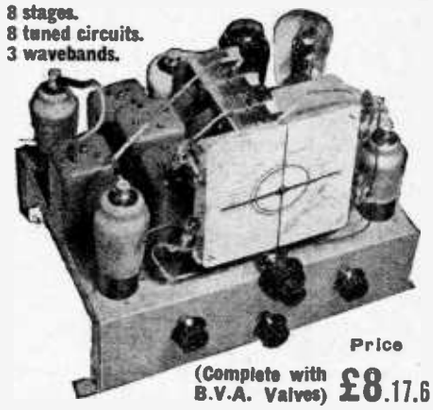
SPECIAL SHORT-WAVE SETS WANTED

A CORRESPONDENT in Cyprus asks us to put him into touch with British firms willing to supply a number of specialised short-wave sets covering wavelengths between 10 and 45 metres. Letters from firms interested in this matter should be addressed to this office, and they will be forwarded.

McCARTHY

6-valve all-wave Superhet with Radio Frequency Stage

8 stages.
8 tuned circuits.
3 wavebands.



Price (Complete with B.V.A. Valves) £8.17.6

Performance (made possible by use of multi-electrode valves) equal to that of many receivers employing 8 valves or more. Brief specification includes: Large "Airplane" dial, with different coloured lights automatically switched on for each wave-range. Micro-vernier 2-speed drive. 4-point wave-change and gramophone switch. Volume control and variable tone control also operative on gramophone. Reinforced heavy-gauge steel chassis. Covers 19–2,000 metres.

Circuit comprises. Preselector circuit, radio frequency amplifier (operative on all 3 wavebands), triode-hexode frequency changer double band-pass I.F.T. coupled I.F. amplifier, double diode-triode detector and L.F. amplifier. D.A.V.C. applied to 3 preceding valves. 3-watt pentode output.

9 VALVE FOUR-WAVE SUPERHET DE LUXE

14 GNS.

(Complete with 9 B.V.A. Valves)

4 wavebands: 12.8-33, 29 80.190-550, 800-2,000 metres. Illuminated dial with principal station names.

Controls.—A feature of the receiver is the number of independent controls fitted, making it extremely interesting to operate. These include sensitivity control (varying bias on R/F stage), or Q.A.V.C. with manual muting control for inter-station noise suppression. 5 position wave-change and gramophone switch. Progressive variable tone control operative on radio and gram.

Circuit in Brief.—Aerial input to pre-selector circuit, radio frequency amplifier, latest type triode-hexode frequency changer, 2 band-pass I.F.T. coupled I.F. amplifiers, double diode detector, triode L.F. amplifier, separate triode phase-changer capacity coupled to 2 large pentodes in push-pull. Heavy 16-gauge steel chassis. Finest components and workmanship throughout. Harries tetrodes in place of output pentodes if desired.

STANDARD MODEL 12 GNS. As above, but with triode push-pull output, and fewer controls fitted

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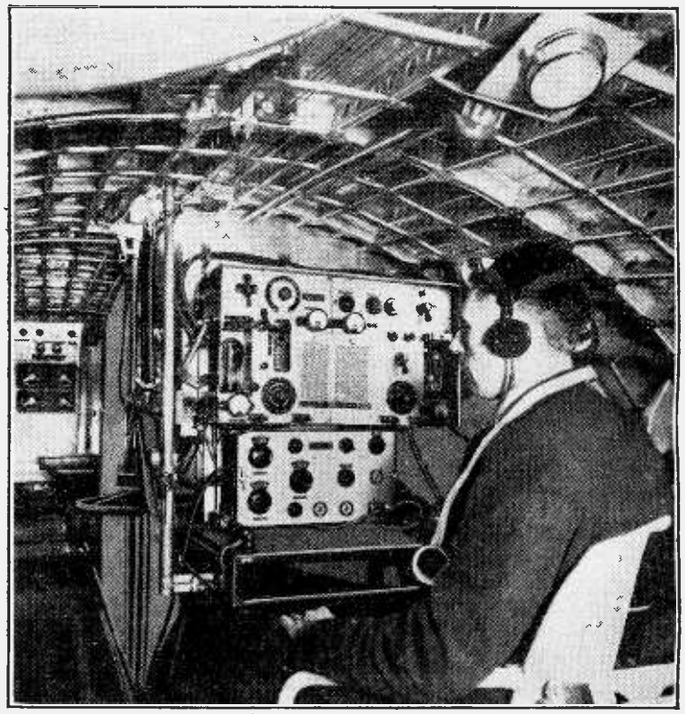
How to Become an AIR WIRELESS OPERATOR

Qualifications, Examinations and Tests

By R. F. DURRANT, A.F.C.



A wireless operator on a new Empire flying boat seen at the controls of the equipment under his charge.

Photo by courtesy Marconi's Wireless Telegraph Company

THE true wireless operator is born, not made. This is especially true if we take the specific case of the marine wireless operator's opposite number—the man at the key in the air. His duties are, if anything, more exacting, and an intelligent air radio operator can be of the greatest assistance to the air pilot, especially when "fog conditions" are in force.

The candidate for a provisional Air Operator's Certificate must pass the Air Ministry examination, which is conducted periodically at the Air Ministry, London, and applicants who desire to obtain this Certificate qualifying them to act as a wireless operator on board British aircraft should apply in writing to The Secretary, Air Ministry, Ariel House, London, W.C.2, enclosing a Postal Order to the value of ten shillings, when an application form will be forwarded.

The applicant must be prepared to produce evidence of British nationality, and must at the time of the examination furnish two unmounted photographs (preferably head and shoulders only, and measuring approximately 3in. by 2in.) to be signed in the presence of the Examiner, and subsequently affixed to the Certificate. He must also produce evidence of good character.

The present certificate is provisional only; at a future time it will be necessary for all holders to be re-examined under the new syllabus to be published in the near future. A further fee will be payable when this procedure comes into force. The present qualifications are based on the syllabus of the examination in the Postmaster General's Handbook for Wireless Telegraph Operators, procurable from His Majesty's Stationery Office.

There are two classes of certificates for an operator, one for telegraphy and telephony, and one for telephony only. The procedure and fee is the same in both cases.

The syllabus of the examination for air radiotelegraphy and telephony includes:—

Elementary theoretical and practical knowledge of electricity and radiotelegraphy, and knowledge of the adjustment and working of the apparatus used in the aircraft service.

Elementary theoretical and practical knowledge of the working of the accessory apparatus, such as motor generators.

Practical knowledge sufficient for effecting minor repairs in case of damage occurring to the apparatus.

Correct transmission and correct reception by ear of code groups (mixed letters, figures, and punctuation marks) at a speed of sixteen words per minute, and of a plain language passage at twenty words per minute.

Knowledge of the regulations applying to the exchange of radio-electric communications, and knowledge of the especial provisions governing the radio-electric service in air navigation.

Elementary knowledge of general geography in relation to communications by wire and radio-electric means.

Candidates will be required to undergo a practical examination consisting of the following tests:—

Connecting up apparatus. Regulating and adjusting apparatus. Tracing and clearing faults. Repairing defective apparatus.

Sending on an ordinary Morse key for three consecutive minutes, at not less than the prescribed speeds, a passage in plain language, and code groups of mixed letters, figures, and punctuation marks. The accuracy of sending, the correct formation of the characters, and the correctness of spacing will be taken into account.

Receiving Morse messages of the types and at the prescribed speeds from a double headgear telephone receiver ordinarily used for the reception of radiotelegraph signals, and to transcribe them legibly.

A test in commercial telegraph working, exchanging traffic as between an aircraft and an aeronautical station.

To undergo a written theoretical examination to which three hours is allotted, containing elementary questions on the subjects given above. The practical examination is at the present time conducted on any standard type of modern aviation radio transmitter and receiver that the applicant has used during his training.

To pass an oral examination in which elementary questions under the following headings will be asked:—

Aircraft aerial systems, winches and fairleads, earth, bonding, wavelengths, magneto interference and its prevention, direction finding, bearings, reciprocal bearings and positions by DF, application of DF bearings, magnetic variation, regulations applying to the exchange of messages by radiotelephony.

To pass a test in communication by radiotelephony as between an aircraft and an aeronautical station.

Progressive Opportunities

Air wireless operators are employed by Imperial Airways on the giant flying-boats operating between Southampton and South Africa and the Far East on the Empire air routes. On these routes telegraphy is exclusively employed. On the inland routes radio-telephony operated by the pilot is sometimes used on British aircraft, but operators using telegraphy are employed in the majority of cases.

Vacancies for wireless operators on British aircraft are normally filled by ex-Service personnel with W/T flying experience, and ex-marine operators who have passed the air operator's examination. A number of wireless training colleges throughout the country have now made arrangements to coach operators for the air certificate.

The question is frequently asked whether the possession of the present P.M.G. wireless operator's certificate to operate wireless at sea allows the holder to carry out similar duties in aircraft. The answer is in the negative.

To the young man who is fond of travel and adventure, a splendid career is open as an air wireless operator. He can, after some experience in the air, qualify for the second-class air navigator's licence, which will enable him in turn to become a pilot and obtain promotion to first officer.

The Radio Industry

AS a result of the increasing demand for rotary converters for operating television sets in DC districts, the Electro Dynamic Construction Company, Ltd., St. Mary Cray, Kent, have issued a supplement to their catalogue showing the appropriate machine for various television receivers.

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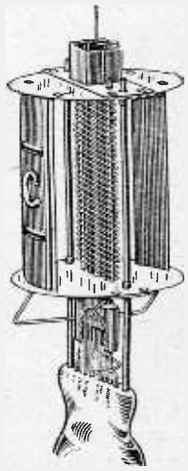
A new descriptive catalogue dealing with the Milnes HT battery system has been issued by Milnes Radio Company, Ltd., Church Street, Bingley, Yorks.



Sketch showing construction and electrode assembly of the Cossor duo-diode-output tetrode, Type 42OTDD. The tetrode, which has a high mutual conductance, serves as a combined detector-AVC-output valve.

NEWS OF THE WEEK

Aerobeam Activities

EXPERIMENTS in connection with the ultra-short-wave radio beacon installed at the Essendon Aerodrome, Melbourne, are reported to have been highly successful. It is hoped to achieve somewhat greater range from the beam early in the New Year after the installation of certain new apparatus.

Wireless and War

IN reply to a recent question in the House of Commons, Sir Thomas Inskip, the Minister for the Co-ordination of Defence, announced that, as a result of investigations, it had been found that existing wireless factories were adequate for providing all the radio needs of the country in time of war.

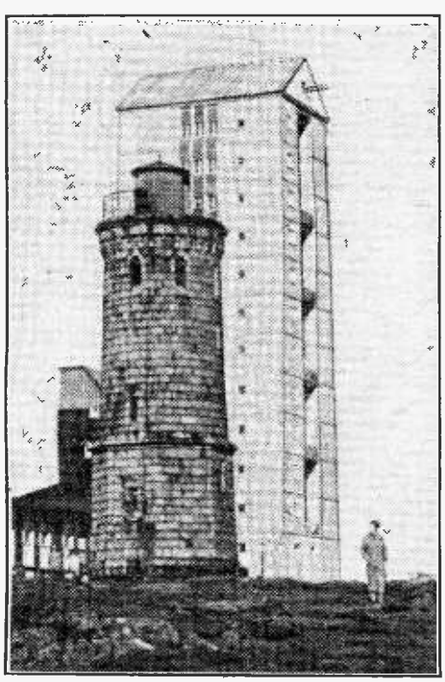
Ultra-Short-Wave Broadcasting

THE power of the ultra-short-wave broadcasting station which, as announced recently in *The Wireless World*, has been opened near Rome, has now been stated officially. It is 2 kilowatts. This station, which works on a wavelength of 6.9 metres, is in operation from 6 p.m. to 9.30 p.m. (G.M.T.).

Special programmes for the Mercantile Marine are now being broadcast every Thursday from 5-5.20 p.m. (G.M.T.) from Rome No. 2 (245 5 metres) and I2RO4 (25.4 metres).

Wireless Warning of Forest Fires

AS part of the Forestry Department's campaign to prevent the recurrence of last year's disastrous forest fires in parts of Queensland, wireless has been installed on a fire look-out tower situated on Mount Benarige, Maryborough, Queensland. This station will work in conjunction with a number of vehicles fitted with wireless installations, enabling them to keep in touch with the look-out men in the tower, and so co-ordinate the work of detecting and fighting fires. Other towers of a similar type are to be erected.



3,800 FEET above sea level. This is the height of the top of Germany's first mountain television station. The 130ft. wooden tower, which is close to the old 50ft. observation tower on the summit of the Brocken, is here seen nearing completion.

"Educational Entertainment"

A CHICAGO school has included among its programmes a mild form of schools broadcasting under the guise of "Informative Entertainment." The reason why schools broadcasts are not given in the U.S.A. in the same form as over here is due solely to the system of broadcasting employed; in other words, the firms who sponsor programmes cannot see how they are going to get a reasonable return for the time and money spent.

Complicated Football Commentaries

THE broadcasting of eye-witness accounts of football matches is far more difficult in America than is the case over here owing to the greater complexity of the game as played in the U.S.A. American football involves, among other things, the awarding of penalty kicks for a very large number of offences, and in order that the commentator can pass on to listeners an intelligent account of what is going on, a wireless "spotter" is placed on the touchline, and it is his duty to find out the reason for the referee awarding a penalty and to pass the information on to the commentator's box by means of hand signals.

U.I.R.

IT is, of course, the Brussels Listening Post of the International Broadcasting Union which has just celebrated its tenth birthday, and is moving to new premises, although the omission of the words "The Brussels Listening Post of" at the beginning of the caption to the picture on page 617 of our December 16th issue may have misled readers.

The International Broadcasting Union (U.I.R.), which has its headquarters at Geneva, is actually nearing its thirteenth birthday.

The note on page 620 of the same issue referred to the recent meeting of the U.I.R. as being concerned mainly with the arranging of the agenda for the Cairo International Tele-communications Conference, whereas it was actually approving certain supplementary proposals to be made by the U.I.R. to the conference.

Australian Amateurs' Conference

IN connection with the World Radio Convention, arranged by the Australian Institution of Radio Engineers, which is to be held in Sydney from April 4th to the 14th, it has been decided to hold a Federal Conference of Australian wireless amateurs. A comprehensive programme is being arranged by the Australian Amateurs' Wireless Institute, and delegates are expected from all over the Commonwealth.

Lectures for Students

A COURSE of lectures on alternating currents and electrical oscillations, which should be of great value to wireless students, will start on January 11th at the Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E.C.3. The lecturer will be Dr. D. Owen, B.A., D.Sc., F.Inst.P. The sessions will take place from 7-8.30 p.m. on Tuesday evenings, and the fee for the course will be 10s.

DEPENDABILITY

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ALL-BRITISH

CONDENSERS

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Recent Inventions

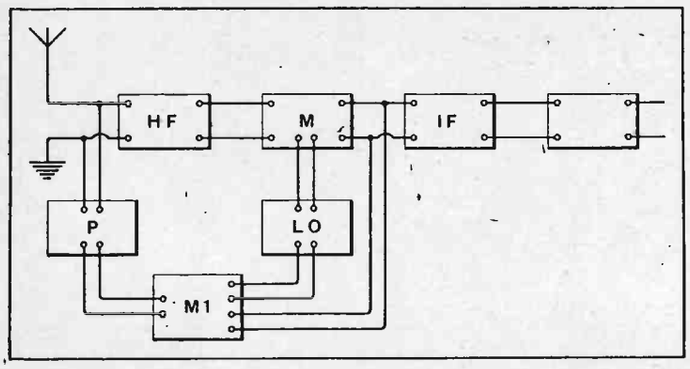
The British abstracts published here are prepared with the permission of the controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each. A selection of patents issued in U.S.A. is also included.

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section.

SUPERHET RECEIVERS

SECOND-CHANNEL interference in a superhet set is eliminated by a method of reaction which feeds back voltages in phase with the desired signals, but in phase-opposition with the undesired signals. The invention is based on the fact that the desired signal can be arranged to fall on one side of the resonance curve of the tuned input circuit, and the undesired or "second-channel" interference on the other side of that curve, thus introducing an initial phase difference, which is developed and utilised in the manner stated.

As shown in the schematic drawing, signals from the preselector circuit HF are combined in the mixing valve M with local oscillations from LO to produce an intermediate frequency at IF in the ordinary way. A portion of the output from M is combined at M1 with oscillations from LO to reproduce the original signal frequencies in a feed-back circuit, which includes a phase-adjuster P. Here the original phase-difference of 90° is converted partly into a component which is in phase with the desired signal, and partly into component which is 180° out of phase with the interference. The latter is accordingly eliminated.



Eliminating second-channel interference in a superhet by phase-adjustment of undesired signal.

J. Robinson. Application date February 24th, 1936. No. 471065.

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SHORT-WAVE SYSTEMS

ULTRA-SHORT waves, below 10 centimetres in length, are received upon an aerial which forms part of the electrode-system of a cathode-ray tube. The aerial is connected to a transmission-line which extends inside the tube and consists of a pair of wires to which discs are connected at half-wave intervals.

The signal currents build up along the transmission line and serve to control the speed of the electron stream (which passes between the pairs of discs). In this way the stream is deflected, or bent out of the straight, so that instead of falling on a central anode at the far end of the tube, it falls upon one or other of two auxiliary anodes which are set out of the centre line of the tube.

The amount of current received by the auxiliary anode is thus controlled by the original signal voltage, so that the tube acts as a detector, and can be followed by one or more low-frequency amplifiers.

Marconi's Wireless Telegraph Co., Ltd. (assignees of E. G. Linder). Convention date (U.S.A.), December 31st, 1935. No. 470805.

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TELEVISION TRANSMITTERS

RELATES to cathode-ray television transmitters of the Iconoscope type, where the scene to be televised is focused by an external lens system on to a mosaic electrode of photo-sensitive cells, which emit electrons under the influence of the incident light and so build up an electrostatic "image" of the picture. This is then scanned by an electron stream which discharges the cells and so produces currents which are used to modulate the outgoing carrier wave.

During this process the photo-sensitive screen emits secondary electrons produced by the impact of the scanning stream. These are usually collected by a suitably-biased anode located near the screen. Some of them, however, tend to stray across the screen on to neighbouring cells and so reduce the efficiency of the latter.

According to the invention, this is prevented by an auxiliary mesh-work grid, which is negatively biased and located close to the screen, the apertures in the grid being aligned with the mosaic of cells.

Marconi's Wireless Telegraph Co., Ltd. Convention date (U.S.A.), January 30th, 1935. No. 471149.

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FLUORESCENT SCREENS

ONE known method of preparing fluorescent material is to grind Willemite in a ball mill into a powder fine enough to pass through a screen of 200 to 400 mesh. This is then applied to the glass bulb of the cathode-ray tube by spraying, or by deposition from a liquid solution. It has, however, been discovered that during the fine grinding process, the natural crystalline structure of the Willemite is distorted or injured to such an extent that it affects the life and the fluorescent efficiency of the screen.

According to the invention, the Willemite, after it has been ground, is immersed in an alkaline solution, such as ammonium hydroxide, for a period of 24 hours. This apparently has the effect of dissolving the outer surface of each particle, and exposing or re-forming a fresh layer or facet. Willemite prepared in this way displays a more intense fluorescence, and is less liable to be burnt out by the cathode-ray stream.

Marconi's Wireless Telegraph Co., Ltd. Convention date (U.S.A.), February 28th, 1935. No. 471190.

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MOSAIC SCREENS

A "STORAGE" electrode, of the kind used in a cathode-ray tube to form an electric image of a projected picture, is made by depositing a layer of aluminium oxide on a plate of the same metal. The picture is first focused upon a transparent photo-electric cathode, made of sensitized wire-gauze, and the liberated electrons are then focused upon that face of the "storage" electrode which is covered with oxide.

The latter acquires a negative charge which, in turn, induces a positive charge on the opposite face of the electrode. This is then scanned by the electron stream from the "gun" part of the CR tube, and the resulting discharges form the signalling currents.

Baird Television, Ltd.; T. M. C. Lance; V. Jones; and P. W. Willans. Application date, February 29th, 1936. No. 471191.

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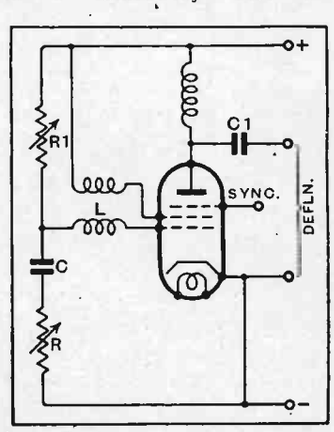
TIME-BASE CIRCUITS

SAW-TOOTHED oscillations for deflecting the scanning stream in a cathode-ray tube are generated by a single back-coupled pentode valve. As shown, the first and second grids of the pentode are back-coupled at L, and the output from the valve is fed to the deflecting plates of the CR tube through a condenser C1.



Pentode valve as oscillator for time-base circuits.

The operation is as follows:—The main condenser C is charged up from the HT source through a resistance R1 until the built-up voltage "triggers" the valve into oscillation, which persists until the condenser C is discharged.

Meanwhile the saw-toothed voltages applied to the defection plates are synchronised by timing signals applied to the suppressor grid of the pentode. Initial control of the frequency is effected by adjusting the resistance R1, whilst the amplitude of the output oscillations is regulated by varying the resistance R.

Baird Television, Ltd., and D. M. Johnstone. Application date February 24th, 1936. No. 470922.

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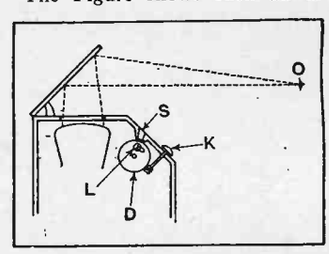
TELEVISION RECEIVERS

IF an illuminated indicator dial is used on a television receiver, it is desirable that it should not distract the view of an observer of the televised picture, though, of course, it must be plainly visible to the operator of the set.

The Figure shows such an arrangement. The indicator dial D is lit by an inside lamp L, and the viewing slit S is so arranged that it comes directly under the eye of a person operating the control knob K, though it is hidden from the view of an observer O situated at the normal distance from the viewing screen.



Method of locating an illuminated dial on a television receiver.

Baird Television, Ltd. and L. R. Merdler. Application date, February 24th, 1936. No. 470920.

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TELEVISION AERIALS

A DIPOLE aerial, as used for transmitting or receiving television, is usually erected at as great a height as possible, and generally in an exposed position. It, therefore, stands some danger of being struck by lightning.

The invention describes a method of fitting an earthed lightning-protector in such a way that it does not affect the signal pick-up (in the case of a receiving aerial). At the same time, the protector forms part of a tuned rejector circuit, which serves to prevent any leakage of signal energy along the outer sheath of the coaxial feed line.

K. H. Barbour. Application date, March 3rd, 1936. No. 471434.